Tawhiti Rahi:

"Nga Poito o te Kupenga o Toi te Huatahi"
[A float of the fishing net of Toi te Huatahi]

A multi-disciplinary study of Māori settlement of Tawhiti Rahi, an offshore island in northern New Zealand.

by
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Poor Knights Islands

The two largest islands are Tawhiti Rahi (north) and Aorangi (South).
[WhangāreiDistrict Council aerial photograph 2006]

ABSTRACT

My archaeological research addresses the question of the role constrained and circumscribed offshore islands played in the initial Polynesian colonising phase and in the subsequent indigenous Māori culture in New Zealand's horticultural north. Specifically it attempts to determine the timing of settlement and the nature of that settlement on the Poor Knights, a group of islands located off the east coast of Northland. This is then used to discuss the regional history of the coastal and island seaway from the mainland out to Great Barrier Island.

Settled by Māori at an unknown time in the prehistoric period, these islands contain today a complex archaeological landscape of earth and stone structures along with faunal and lithic assemblages that are associated with Māori society just before contact with the western world. The fieldwork has focused on Tawhiti Rahi Island, the largest island in the group, and one that contains a remarkably well preserved prehistoric archaeological landscape variously interpreted by ethnographers, scientists and archaeologists as gardens, villages, defended forts as well as ceremonial and specialist areas. This island is interesting because despite the obvious horticultural potential from its volcanic soils, sheltered topography and temperate climate, it also has significant constraints on settlement such as difficult access, minimal water supply and a limited range of non-garden related exploitable resources especially when compared to other nearby coastal islands and mainland localities.

Utilising a multi-disciplinary approach a range of natural science techniques, archaeological methods and historic and traditional sources are used to establish and explain when and why this island was settled. Results of the palynology research create a vegetation history of the island that provides proxy evidence for 500 years of gardening starting around 1300AD at the beginning of New Zealand's prehistory. Archaeological survey and excavation show a complex constructed landscape that shows some direct garden activity in the middle of Māori prehistory around 400 years ago but most significantly show a significant increase in human activity at the very end of the prehistoric sequence that continues on onto the early historic period. Ethnographic and traditional history places these islands within the tribal territory of Ngatiwai that currently incorporates coastlines and islands from the Northland mainland out to Great Barrier Island, and identifies that gardens, mutton-bird and refuge potential as the primary reasons for many generations of use of Tawhiti Rahi. However the traditions are ambiguous when it comes to a chronology of island settlement. Although clearly identifying an early discovery and naming, they surprisingly place the arrival of the islands first chief as occurring very late in the sequence only 200 years ago. Finally there is the absence of the Polynesian rat kiore, (*Rattus exulans*) on the Poor

Knights. Since kiore are commensal with Polynesian settlement and they are found everywhere on the New Zealand mainland and on nearly all inshore and offshore island groups, their lack here raises serious questions about our assumptions on how long these islands were settled, the intensity of that settlement and on the role of agency.

It is suggested that an integration and reconciliation of these apparently conflicting data sets is possible. This thesis suggests that this island was in continuous *use* by Māori for 500 years from 1300 AD right up to their abandonment in 1823. However for the first few hundred years they were utilised only as a valuable garden outlier for people living at less constrained settlements on the mainland. Full and permanent *occupation* of the island that produced the diverse range of site types visible on the ground today, occurred much later in the prehistoric period as a direct response to inter-tribal conflict that was escalating in the 1700s.

The implications of the data obtained from Tawhiti Rahi suggests that for Māori in prehistory these islands were not seen as a special case with a different and separate story to that found on the mainland. Instead they are component parts of a tribal maritime territory that included the mainland coast and offshore islands in a seaway sheltered by Aotea (Great Barrier) Island. Although the nature and timing of settlement may have followed different trajectories depending on the unusual mix of opportunities and difficulties inherent with living on this peripheral island, it is argued in this thesis that their actual usage of Tawhiti Rahi was entirely contingent on what was happening politically, economically and socially within Māori society in general. In this framework it is the sequence of 'presence and absence' scenarios left behind on this circumscribed island that allow for a discussion about change over time in the Māori history of this coastal region.

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E mihi ana kite rangi
E mihi ana kite papa
Ki te whanau o Ngatiwai e hui hui ne, tēnā koutou
E nga rangatire o Ngatiwai, tēnā koutou
Kapiti hono, tatai hono, te hunga mate, kite hunga mate
Kapiti hono tatai hono, te hunga ora, kite hunga ora
Norera, tēnā koutou, tēnā koutou, tēnā koutou katoua

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Chapter 1: Circumscribed Islands in New Zealand Archaeology

1.0 Introduction

In New Zealand's warm temperate north the sheltered waters off Northland's east coast contain numerous inshore and offshore islands that were utilised by Māori prior to European arrival. One such group is the Poor Knights. These offshore islands were a focal point for Māori settlement and at the time of European contact supported a large population. What is not well known however is the timing and nature of settlement on these islands and whether it mirrored or differed from that found on the Northland mainland.

The distinctive Māori society that occurred here incorporated cultural elements brought from the Pacific homelands by a small founder population of Polynesian colonists, as well as cultural elements created independently in New Zealand. This development reflected the opportunities and constraints of people living in isolation in an environment that had a very different geology, topography, biology and climate from the tropical east Polynesian small islands that they had come from. The archaeological record for New Zealand is extensive; however the interwoven evidence for both cultural change and continuity is often difficult to disentangle within New Zealand's short 500 year prehistory. What is needed is one site occupied continuously throughout New Zealand's short 500 year prehistory containing stratigraphical evidence showing both change and continuity from a distinctive Polynesian origin to a classic Māori end. Due to the mobile nature of Māori society we have yet to find such a site. It is argued here that compared to mainland communities some islands on the periphery of Māori society with both a particular resource value as well as specific circumscriptions or physical constraints, may have been continuously used in ways that leave behind much clearer evidence about how and when they were used. In this context the more peripheral and circumscribed such an island is, the more likely it is to leave a clear signal of such settlement in the archaeological record.

This research is concerned with the regional archaeology of New Zealand's Northland central east coast that. This is part of the rohe (territory) of the Ngatiwai Iwi who have a maritime history focused on the coasts and islands of this sheltered seaway. In this seaway I have undertaken a multi-disciplinary study about Māori settlement on Tawhiti Rahi, the largest island in the Poor Knights offshore island group. Utilising a series of presence and absence scenarios created by circumscriptions and degrees of insularity inherent in this island the research focuses on primary questions about who were the people that settled here, why did they come and when did they arrive? Similarities and differences in the trajectory of Māori settlement between this peripheral island and the central mainland develop a narrative about the prehistory of this coastal region.

1.1 Island Archaeology

This section starts with an overview of the different ways archaeologists have used island archaeology to investigate the establishment and spread of prehistoric societies. It will summarise the key questions answerable by island archaeology and identify which of them are relevant to this thesis and will be used to create an island history. This is followed by four sections that look at island specific archaeology. Starting in south Polynesia I demonstrate why variation over time in the relative isolation of islands is relevant to our understanding of human settlement in New Zealand's short prehistory. Then I look at the archipelago that is New Zealand and see how it relates to the themes of colonisation, environmental change and insularity, and where 'presence and absence' scenarios in the archaeological record (i.e. archaeological discontinuities) on the subclass of offshore islands may give insights into these themes not available elsewhere. The last two sections look at the reasons why the peripheral and constrained Poor Knights Islands group was chosen for study and why Tawhiti Rahi (the largest island in the group) in particular provides an appropriate set of conditions to answer the thesis question.

1.1.1 Island Archaeology Approach

Island archaeology became a distinct subfield of general archaeology in the 1970s and according to White (2004) cited by Renfrew, it is based around the premise that islands "can make things visible" (Renfrew 2004:283). Exactly why islands are special is difficult to define except that they;

> "…imply boundaries between the land and the sea… (and)…represent topological discontinuities" (Renfrew 2004:283)

Today the sub-field of island archaeology has practitioners who take an array of approaches and who hold widely divergent theoretical positions. These range from the processual archaeologists who give strong support to the idea that islands are special and distinct from mainlands (Evans 1973; Cherry 1981), to that of post-processualists such as Robb (2001) and Rainbird (1999, 2007) who argue that all islands are connected and therefore not different from mainlands. What has become apparent is that land/sea boundaries associated with islands can allow us to study what is happening both on and between them in a way that is "difficult to achieve on larger continental landmasses" (Terrell 2004:207). In that sense they can represent both 'isolation' and 'inter-connectedness' depending on differing frameworks of study (Renfrew 2004:283; Conolly

&Campbell 2007; Knapp 2008). This perception has encouraged a growing middle ground that views islands as being significant within the context of maritime cultural landscapes in a way that is distinct from how we view terrestrial cultural landscapes (Fitzpatrick & Erlandson 2006).

Within the context of this vigorous and to some extent still polarised debate on whether islands are insular or connected, Broodbank (2000:3) revisited and reviewed island archaeology and suggested an inclusive framework of enquiry that could be applied to islands around the world based on the idea that for human settlement, insularity was clearly influenced by bio-geographical factors, but that it was determined by cultural factors. He called for 'island histories' and argued strongly that they be based on archaeology but informed by environmental sciences and studies of historic records. He explicitly recognised that Pacific archaeologists were leading this field and advocated more complex analyses and methods to be used to answer questions common to island archaeology studies around the world. These are paraphrased here as:

- When and why did people g
- o to islands?
- How did they choose to live there afterwards?
- How did people's lives shape – and how in turn were they shaped by – the physical and cognitive aspects of islands?
- What kind of interaction took place from island to insular island, and from island to non-insular mainland?
- How did external contacts affect the culture of islanders?
- How and why did island society end on islands?
- What were the causal relationships between patterning in human life and insular fauna and flora?

This research focuses on three themes defined as processes of colonisation, degrees of insularity and measuring environmental change. It will use the archaeological record informed by pollen studies, as well as oral and written histories to develop just such an island history of Tawhiti Rahi.

1.1.2 Island Archaeology in South Polynesia

South Polynesia is defined here as the outlying archipelagoes of Chathams, Kermadecs, Norfolk. Lord Howe and the Subantartic Islands that lie 500-800 km off the New Zealand mainland (Anderson 2006:26). Their archaeology suggests that despite the colder climate and radically different environments, an initial period of Polynesian colonisation occurred on nearly all island groups, not just the New Zealand mainland. Human populations on the smaller islands with limited resources such as Norfolk, Kermadec and the sub-Antarctic Auckland islands, proved non-viable and all were ultimately abandoned. Populations on the extremely isolated Chatham Islands group did become self sustaining and ultimately developed their own trajectory of settlement in isolation from New Zealand (Anderson 2004:256; Davidson 1990; Maxwell 2014; Sutton 1982). Based on significant increases in population size, it is only in and around the main islands of New Zealand that human settlement can be seen to be successful. Cut off for 500 years from the rest of the world, Māori society developed and changed through internal interactions. Depending on one's perspective, Māori society can be seen as both isolated and interconnected. This reciprocity is visible in the Pacific in Near Oceania where long settled and often inter-visible islands have interaction rich seascapes that are visible in the archaeological record. This is less commonly found in islands in Remote Oceania where relative isolation occurs, probably due to islands being smaller, widely dispersed, only recently settled and having a simpler biogeography (Anderson 2004:253-4). This thesis explores issues of relative isolation at a smaller scale within offshore interaction groups. As long as there are differences in ease of access and resource availability, islands in these groups should be experiencing measurably different levels of spatial and temporal interaction from that found on central mainland communities. Another way of looking at this is that within island to island interaction zones and island to mainland interaction zones, the more peripheral or isolated a given island is the more likely it is that human usage there will be contingent on broader social and political realities.

1.1.3 Island Archaeology in New Zealand

Although popularly viewed as only two (slightly) separated large islands, it has been argued that New Zealand should instead be perceived as an archipelago of many islands (Towns & Daugherty 1994). These islands were first settled around 1300 AD by voyagers from East Polynesia who over the next 500 years developed the indigenous Māori culture in isolation from the rest of the Pacific (Anderson 1991, 2002, 2003; Higham et al 1999; Shawcross 1969; Walter and Jacomb 2007; Walter et al 2010). Aside from the very large land masses of the North and South Islands, there are thousands of smaller islands along with stacks, shoals, sandbars and rocks that start only a few metres from shore, to some that are located many hundreds of kilometres away from the mainland. Over the years these have been described in many ways, but from the 1950s onwards, biogeographical studies began to divide them up into categories that are recognised today as inshore, offshore and outlying islands (Cochrane 1954 & 1957; Edson 1972; Atkinson 1986; Russell 2002). For this research then, outlying islands are defined as those islands not visible from the mainland of New Zealand. These are few in number but include the Auckland, Chatham and Kermadec islands. Inshore and offshore islands are more numerous, are highly variable in size, but are all characterized by being inter-visible with the mainland. Out of some 4163 inshore and offshore islands, stacks, rocks, reefs and sandbars that lie between East Cape in the south-east and the Three Kings Islands in the north there are 80 islands 10-99 ha in size and 41 islands larger than 100 ha (Taylor 1989, Table 1). These diverse islands range from being close inshore to nearly 60 km offshore but are always inter-visible with the mainland. All lie within a climate zone suitable for cultivation of introduced tropical food plants and nearly all contain prehistoric archaeology (Davidson 1990:151).

Unlike inshore islands, that are effectively part of the mainland archaeological landscapes, the less numerous group of offshore islands have a slightly ambiguous role in prehistoric Māori society. A number of these islands such as Aotea (Great Barrier), Ahuahu (Great Mercury) and Hauturu (Little Barrier) are considered to be optimum localities for settlement. They are large in size, have a broad range of environmental zones containing easily obtainable wild food resources, permanent water supplies, and have areas with a high potential for introduced horticulture. All of these optimum islands were exploited by Māori early in prehistory (Cochrane 1954; Edson 1973) and as such we might expect such islands to mirror the mainland with regard to the timing and nature of human settlement. In contrast, smaller offshore islands like the Poor Knights, Taranga (Hen) and Marotiri (Chickens), the Three Kings (Manawa Tawhi), and the Mokohinau Island groups place significant constraints on human settlement. These include a limited range of exploitable environments, marginal water supply and difficulties of access. Although these smaller islands (apart from the Mokohinau Group) had a high potential for horticulture, by most criteria they should represent a peripheral landscape for human use. How then are we to explain the extensive archaeological landscapes built on these islands in the prehistoric period?

To date the archaeological evidence of human settlement on offshore islands has been largely uninvestigated. What we do know is that all islands in this zone with the potential for horticulture appear to have been gardened at some time and to some extent in their history (Cochrane 1954; Edson 1973). Edson's belief that horticultural potential was the major operating factor in the extent and duration of settlement may be correct but is still unproven (Edson 1973:8). Similarly we also know that Māori occupation of both peripheral and central islands was extensive in the early years of European contact (Nicholas 1971, Cruise 1957, Cochrane 1954, Fraser 1925, Edson 1973) but we are unsure when this settlement started. The identification of artefact types found on Ahuahu (Great Mercury) Island as being early or 'archaic' in style (Edson 1973:150), along with the significant vegetation changes visible in pollen records for Aotea (Great Barrier Island) between 1200 and 1300AD, have both been interpreted as evidence for early human presence (Deng 2004). Despite this, the antiquity of settlement on at least the more marginal of the offshore islands has not yet been archaeologically documented.

1.1.4 Why the Poor Knights?

The Poor Knights island group is located 26 km off Northland's eastern Tutukaka coast. It consists of two large islands of Aorangi (150 ha) and Tawhiti Rahi (180 ha) that, along with a number of smaller islets and stacks are the eroded remnants of a rhyolitic eruption that occurred three million years ago. For the larger islands this eruptive origin has resulted in vertical curtain coastal cliffs that can extend over 100 m high. These cliffs protect and shelter valley and plateau interiors that are currently shaded by a continuous vegetation canopy of pohutukawa forest. Compared to the Northland mainland and most other island settlements in these eastern waters, the Poor Knights Islands contain an unusual set of natural and cultural characteristics which both encourage and inhibit human settlement. The environmental constraints that should have made it less desirable for human settlement include being located a significant distance offshore, lacking many lithic resources, limited fresh water, lacking any sandy shore or estuarine locales that could be exploited for food, and being girt by encircling cliffs that in anything but a dead calm severely restrict access. In contrast, certain aspects of the environment encourage human settlement. These include the island's location in a temperate climate zone, a naturally defensible topography, the presence of silty volcanic soils found in sheltered interior locations that are well suited for horticulture, and a resident population of seabirds easily harvested as a seasonal mutton-bird resource.

1.1.5 Why Tawhiti Rahi?

In the Poor Knights island group, Tawhiti Rahi was chosen as the primary focus of research because (i) although the largest island, it has received the least attention from archaeologists, (ii) it is topographically more circumscribed than Aorangi, at least in terms of access, (iii) it experiences severe limitations in the availability of fresh water, but also has extensive areas of volcanic soils with induced fertility, (iv) it contains the most extensive and complex archaeological landscape to be found in the island group and (v) unlike Aorangi, it never had a pig population that caused extensive damage to its landscape after human settlement of the islands ended.

Tawhiti Rahi has a complex cultural record of occupation. It contains a prehistoric archaeological landscape of stone and earthwork features (Bartlett 1964, Hayward 1993, Lawlor 1988, Leahy & Nichols 1964) that have been variously interpreted as gardens, villages, pa and burial areas, along with a significant amount of portable material culture associated with Māori society at the time of first contact with the western world. By chance the archaeology of this peripheral island is remarkably well preserved. Like Aorangi this is due to an abrupt end to settlement following inter-tribal conflict in December 1823, and because Tawhiti Rahi was never re-colonised by either Māori or Europeans. The lack of subsequent human impact on Tawhiti Rahi was due initially to a placement of a Māori 'tapu' by Chief Te Tatua, and in European times to the island being designated as a Crown Nature Reserve. Apart from 200 years of regenerating vegetation and recovering colonies of burrowing seabirds, the permanent abandonment of this island has contrived to leave the surface components of the 1823 archaeological landscape in near pristine condition.

Two additional important characteristics to the study are the absence of Kiore, the commensal Polynesian rat (*Rattus exulans*) from the group as a whole, and the presence of the European pig (*Sus scrofa domesticus*) on Aorangi Island but not Tawhiti Rahi Island. Brought to New Zealand by the earliest Polynesian voyagers around 1300AD, kiore are found throughout mainland and island New Zealand (Wilmshurst 2004, 2008). However of the 47 islands in northern New Zealand that are over 100ha in size and contain complex archaeological landscapes, only the Poor Knights and Three Kings Islands off Northlands coast and Moutuhora off the Bay of Plenty coast do not support a population of kiore (Taylor 1989:6). This raises the possibility that settlement on these islands was either later than, or of a different nature to that found on the mainland and other islands.

The Polynesian pig was part of the parcel of cultigens and domesticated animals that was introduced to many islands in the Pacific by Polynesian voyagers but was not successfully introduced into New Zealand (Davidson 1984). Instead, the European pig was introduced in the in the historic period by either early explorers or, between 1769 and 1800, by New South Wales Governor King from Norfolk Island (Beaglehole 1955, Belich 1996). Unlike other introduced animals such as sheep or cows, pigs could forage for themselves, and so fitted well into the way traditional Māori society functioned. Pigs became especially important when the whaling provisioning trade in pork and potatoes developed in the early 1800s. The introduction of pigs to islands by Māori is occasionally noted in the ethnographic literature, so their presence on Aorangi Island in the Poor Knights group confirms that Māori settlement of Aorangi that started in prehistory continued into the historic period. The absence of pigs from Tawhiti Rahi Island however hints that different types of island use were occurring late in the settlement sequence within the Poor Knights group as a whole. In a sense the kiore and the pig can be said to 'bookend' our understanding of settlement on the Poor Knights.

Tawhiti Rahi Island was chosen as a case study because it contained three conditions that made it a useful test case for identifying and measuring cultural change. The first condition is that for some periods it was arguably a peripheral environment for Māori. Since it was also extensively utilised at other times, this suggests that it had moved both into and out of mainland social systems in a way that might be visible in the archaeological record. A second condition is that the historically documented abandonment of the island by people in 1823 was both abrupt and permanent and so left behind an unusually well preserved and potentially contemporaneous archaeological landscape. The third condition is the island's long term bio-geographical isolation before human settlement started and its subsequent biological isolation after that settlement ended. This provides an environmental 'control' against which anthropogenic changes to the natural environment can be measured.

1.2 Research themes

This thesis details the prehistory of Tawhiti Rahi within the Poor Knights Islands group, situated within the coastal region along the east coast of Northland, New Zealand. The research takes a multi-disciplinary view in exploring the nature and timing of Māori settlement on this peripheral offshore island through three inter-related themes of colonisation, environmental change and insularity.

1.2.1 Colonisation

In archaeology colonisation is commonly limited to a description of how and why people migrate to a new area. This is a narrow interpretation of this concept, especially in the eastern Pacific where studies of prehistoric colonisation have tended to revolve around settlement of uninhabited landscapes by a single cultural group (Rockman 2003:8). This thesis is concerned with change over time and takes a broader view of the island history of Tawhiti Rahi. Starting with initial settlement, it looks at how people coped once they arrived, and what strategies they subsequently adopted in order to live in this new place. These strategies will have had a complex effect on the island's environment. To understand this, the research will still utilise the useful term 'colonisation' but define it more broadly to include the concept derived from historical ecology that there is a dynamic and ongoing interplay between cultural action and environmental response.

1.2.2 Environmental Change

On Tawhiti Rahi, the theme of environmental change can be closely linked to human exploitation. This research uses environmental science to focus on how changes in both indigenous and exotic flora can indirectly identify the anthropomorphic event sequence on the Poor Knights Islands. Interpretation of these environmental changes can help identify when people first arrived on the island, the changing ways people utilised the island, and what happened after they abandoned the island. The primary tool used for investigating environmental change was pollen analysis, allowing reconstruction of the island's vegetation sequence. From a baseline of the island vegetation prior to human arrival, dramatic changes in the island's vegetation history can be tracked and studied. As a proxy for anthropogenic activity these vegetation changes can be interpreted to indicate the arrival, departure, and to a lesser extent the nature of human settlement on Tawhiti Rahi – the largest island in the Poor Knight group.

1.2.3 Insularity

The final research theme concerns the impact of natural and cultural insularity on islands. In the context of this research insularity is defined as a measure of connectedness. To this end traditional, oral and historic sources have been used to investigate the relationship of the society living on the peripheral Poor Knights Islands to the wider community. Our understanding of settlement on Tawhiti Rahi has been constructed from the archaeological record and then informed and interpreted by the evidence of environmental change and the historic record. While their offshore location has effectively isolated the natural world of the Poor Knights from the mainland, it clearly did not stop people coming to the island and making use of its resources. The research investigates how specific circumscriptions are defined here as difficult access, physical separation and distance from the mainland, and isolated biota - acted as either constraints or opportunities for human settlement. The fact that these islands were settled at all suggests that the process of overcoming circumscriptions or reinterpreting them as opportunities should leave behind a signal to archaeologists about the extent, nature and chronology of settlement. The insularity found on Tawhiti Rahi may offer information about processes of human settlement that is clearer than that so far found on other islands and the mainland.

1.3 Thesis Question

How can the unique archaeological record found on some of New Zealand's offshore islands inform us about processes of settlement within a wider regional context? The islands chosen to investigate this question are the Poor Knights. Previous archaeological surveys suggest that the group was settled in prehistory by Māori who left behind a complex archaeology. Did their location on the periphery of Māori society therefore cause them to move between isolation and interaction with other communities in ways that create visible discontinuities in the archaeological record? If so, did this result in a timing and/or nature of use that differs from that found on the mainland?

This research asks, "Does the time scale and the nature of cultural development on this island differ from that found on the mainland or other more central islands"? Using ideas of (1) human colonisation and adaptation to this island (2) the ecological history of human impact on the island environment and (3) the significance of natural and human insularity, this thesis will investigate who settled these islands, when this occurred, and why people utilised them.

1.4 Research Design

The research was designed to directly address research questions raised by the three issues of colonisation, environmental change and insularity. The particular set of presence and absence scenarios created by Tawhiti Rahi being a peripheral and circumscribed offshore island was investigated through a core of archaeological survey and excavation research. This research will then be informed by data from the environmental sciences and finally from comparative information from historic and traditional sources. The three approaches used in this multi-disciplinary study are as follows.

1.4.1 Archaeology

Archaeology engages with all three themes of colonisation, environmental change and insularity and addresses questions about the length, nature and timing of human settlement and how degrees of connectedness changed over time. Previous archaeological fieldwork on the island had briefly identified a complex, apparently contiguous, and remarkably well-preserved landscape that is now obscured by 180 years of natural re-vegetation.

The archaeological landscape was looked at in three ways. First with archaeological survey, where the surface landscape was mapped using both old and new archaeological technologies, and a site typology developed using a qualitative classificatory-descriptive approach. Second, representative sites chosen from the resultant survey data were excavated in order to determine site function, and to enable collection of material for radiocarbon dating to determine site chronology. Third, a study of portable material culture was made, looking at faunal, floral and lithic material to identify the timing of settlement and connections to other communities. In particular the sourcing of the non-local obsidian previously found to be widely distributed over large areas of the island was undertaken to indicate social links between the Poor Knights Islanders and populations on the mainland and/or other offshore islands. Through these archaeological clues a picture of how the island was used or not used over time and space can be made. From this, an assessment can be made of how connected these islanders were to other communities in this coastal region.

1.4.2 Historical Research

In the context of this thesis, historical research is interpreted broadly to include a range of historic books, journals, early Admiralty charts and unpublished material. In addition, traditional information resources including published ethnographies, early Native Land Court accounts, on-line genealogical research and personal accounts by Ngatiwai informants have been used to discuss aspects of island colonisation and insularity.

1.4.3 Environmental Science

Environmental science examines environmental change. It can provide a picture of the islands' natural ecosystem prior to human arrival and help us understand the subsequent processes of anthropic environmental change that occurred following human colonisation. The key environmental science used was palynology, used to reconstruct a vegetation history for the islands and indirectly address questions about the length of human occupation and the nature of this human settlement on Tawhiti Rahi.

1.5 Thesis Structure

This thesis is set out in six chapters.

Chapter one provides an introduction to the location and overview of concepts important to the research.

Chapter two sets out the methodology of the fieldwork. It will revisit the primary research questions from Chapter one and set out in detail how they are going to be answered from a core of archaeology that is informed by historic research and the environmental sciences.

Chapter three focuses on historical research. It sets out the scope of the research undertaken along with the types of historical resources utilised (or not utilised). It will review the history of the Poor Knights Islands within the context of Northland prehistory and New Zealand's temperate offshore islands. At the end of the chapter a historic context will be presented that reflects the timing and nature of human settlement on Tawhiti Rahi.

Chapter four presents the environmental research in three parts. Part I presents a review of our knowledge of the island's topography, geology and biology. In Part II, the pollen coring project is described and a description of the vegetation sequence obtained from the pollen is given. Radiometric dates taken from the cores are discussed, and an appropriate age/depth model is presented. Based on the dated pollen sequence and the charcoal in the core, a vegetation history of the island is presented and implications about the timing and nature of human settlement are made. Finally in Part III, the presence of pig and the absence of kiore will be examined with regard to the timing and possible nature of human settlement on the Poor Knights.

Chapter five highlights the archaeology. The chapter contains the archaeological data collected during five months of fieldwork undertaken on Tawhiti Rahi between 2005 and 2008, includingthe survey of much of the island's archaeological landscape, recorded down to the feature level, the excavation of various sites and artefact analysis from both the survey and excavations. This data is presented in fourparts and includes an assessment of how the data can inform us about the nature and timing of human settlement on this island. Part I reviews the history of archaeology on Tawhiti Rahi and then presents results of the current island survey via a GIS approach that works at the feature level to show the nature and distribution of both features and artifacts across the complex archaeological landscape. Part II details the representative survey sites for excavation, and a detailed discussion of excavation results is given. Part III discusses the nature and distribution of portable cultural heritage material identified from the survey and excavations with regard to lithics, fauna and flora. Finally in Part III, the identification of koiwi (human remains) are discussed with regard to the permanent or transient nature of Māori settlement on Tawhiti Rahi, and how this settlement ended.

Chapter six summarizes the research and reviews the results. The results from archaeology are then examined in conjunction with our understanding of history and the natural sciences to present a coherent island history of Tawhiti Rahi. The nature and chronology of settlement identified by this synthesis is then discussed with regard to understanding the archaeology of the wider coastal and island region around the Poor Knights Islands.

Chapter 2: Research Methodology

2.0 Introduction

This archaeological thesis presents a multi-disciplinary research approach to investigating the human history of Tawhiti Rahi, the largest island of the Poor Knights group. The core of this research is a detailed archaeological survey of the island and the subsequent excavations of key site types. This broad foundation of archaeological information is then informed by relevant historical knowledge and environmental science. The differing and complementary strengths of the three approaches of history (Chapter 3), environmental science (Chapter 4) and archaeology (Chapter 5) allow for a comprehensive summary of island occupation. Chapter 6 provides an integration of findings from these three approaches and addresses the questions of: who were the people who used Tawhiti Rahi?, what is the chronology of human use of the island?, and what was the nature of this use. The synthesis is then used to discuss the broader regional history of this area of coastal seaway.

Although all three disciplines used in this multi-disciplinary approach address the same questions of 'who', "when" and 'why', they come from very different positions in the research spectrum. History is a core humanities subject while the environmental studies technique of pollen coring is a hard science. Archaeology however sits in the grey area between the two and incorporates aspects of both approaches to form a 'soft science'. Because of these differences the three disciplines vary fundamentally in the types of information collected and analysis of that information. My interpretation of the human history of Tawhiti Rahi Island is based on 'reading' archaeology through a lens of history and environmental science research. Both in this chapter regarding research methodology, and the subsequent data chapters, I will discuss archaeology after presenting historical and environmental science information.

Starting with an overview discussion about island colonisation and intra-island variation, this chapter outlines the methodology underpinning the Historical Knowledge chapter (Chapter 3), Environmental Science chapter (Chapter 4), and Archaeological Research chapter (Chapter 5) that examine human occupation of the Poor Knights Island group.

2.0.1 Island Colonisation

Originating in Africa the colonisation of the world by homo species began with the movement of Homo erectus north through Europe and east through to the Eurasian continent. Recent evidence from Dmanisi in Georgia (Garcia 2010) and earlier investigations in China of Peking Man (Frängsmyr 2012) and in Island South East Asia of Java Man suggest this was a complex process with the likelihood of multiple 'Out of Africa' events at different points in time over possibly 1.8 million years. Homo erectus therefore is present very early in those parts of the world permanently connected by land, and those islands there that were periodically connected to the mainland during repeated glacial periods when sea levels dropped. An ability to use or cross waterways by Homo erectus is implicit in this settlement but there is no evidence that large water gaps were crossed.

The first evidence of the colonisation of islands - defined as lands permanently separated by water - occurred only after the appearance of Homo sapiens sapiens (anatomically modern humans) approximately 200,000 BP. Their presence in places isolated by water such as the Americas sometime around 22000 BP and from Cyprus in the Mediterranean when Neolithic farmers appeared around 10800 BP (Swiny 2001). However the most complex and well understood process is found in the Pacific with the human settlement of the Australian continental shelf. Comprised of Australia, Tasmania, Papua New Guinea, and neighbouring islands this shelf is commonly referred to as Sahul, and it remained separated from the Asian continental shelf known as Sunda throughout the period of human evolution by a deep water zone referred to as the Wallace Line. This physical gap forms a real biogeographical barrier as can be seen with the marsupials that arrived before the gap was formed being replaced in the west by the later arriving mammals but remaining dominant in the east where mammals could not reach. This gap was a significant barrier to human colonisation. Current archaeological evidence from Papua New Guinea (Summerhays 2009) and carbon dates from human burials at Lake Mungo in Victoria Australia (Thorne et al; 1999) date human arrival in Sahul to around 40,000 BP and possibly as early as 60,000 BP by hunter gatherer groups from South East Asia. The implications of this settlement by anatomically modern humans is that they had some form of maritime technology that enabled them to leapfrog across intervisible islands (up to 50km apart) with enough individuals to establish a viable colonising population.

The settlement of the Pacific originated from the Sahul continent. As a broad model looking East from Papua New Guinea to the North and South American landmasses, the islands to the west in Melanesia are characteristically larger, more numerous and for a large part located close enough together to become intervisible. However to the east they become smaller, fewer and more widely scattered and for the most part are no longer intervisible. In addition there are two further water gaps, one of 150km between Melanesia and Western Polynesia and one of 400km between Western and Eastern Polynesia. The peopling of Island Melanesia had occurred as early as

40,000 BP and involved settlement and interaction between major island group such as the Bismark Archipelago and the mainland of Papua New Guinea. However movement across the 150km gap to Western Polynesia did not occur for another 25000 years.

The resumption of human settlement of the Western Pacific required a combination of better boats and the development of navigation techniques that worked out of sight of land, and a cultural model that rewarded this in the face of the serious and significant dangers involved with long distance island voyaging. It is significant that this did not happen until after the advent of plant and animal domestication and sedentism associated with the appearance of more complex social organisations. Around 5000-6000 BP Austronesian speaking Neolithic people emerged out of East and South-East Asia. Sometime around 3600 BP one branch of this linguistically defined group known today as 'Lapita' emerged amongst the numerous people in Melanesia as an archaeologically distinct group that colonised the Western Pacific. Named after a type site in New Caledonia and defined by a particular type of dentate stamped pottery. By 3000 BP they became the first people to explore and colonise an area extending from the Bismarck's east for nearly 6000km though to Fiji, Samoa and Tonga. The wide spread distribution of their distinctive ceramic, lithic assemblages and language type within the Lapita homeland, implies that they both established and then maintained social links through voyaging until around 2500 BP. The fact that their eastern boundary falls along the western side of the 400km water gap that divides Western and Eastern Polynesia suggests that this gap was again too large for their maritime technology and/or cultural interaction sphere to cross.

The crossing of this 400km water gap and the eventual settlement of Eastern Polynesia fell to the descendants of the Lapita people, the Polynesians. Having developed double hull sailing canoes along with advanced navigational techniques and again having a cultural model that encouraged this to occur, these people colonised all the uninhabited island groups in a triangular area between Hawaii, Easter Island and New Zealand. This process was extremely rapid and the timing of it is still debated, but a meta-analysis of carbon dates suggests that a two stage process occurred with an initial move to the Society Islands between 925-830 BP and then the remaining islands including New Zealand being settled between 760-640 BP (Wilmshurst et al 2010). Linguistically the eastern Polynesian language subgroup has shared characteristics not all found in other Polynesian languages and this along with consistent material culture recovered archaeologically suggests that the settlement of New Zealand in the South Pacific originated somewhere in the Society/Marquesas'/Cook Islands region of the eastern Pacific. As the last major landmass of the world (apart from Antarctica) to be settled by humanity, New Zealand is geographically interesting. The persistent pattern of islands and island groups becoming smaller, more scattered and widely dispersed as people moved east through the Pacific, dramatically changed in New Zealand where for the first time since colonisation of the Pacific began in Melanesia, a complex archipelago of small and large islands and mainlands was encountered by the Polynesian settlers.

In summary the geographical isolation of islands strongly constrains biological colonisation, however for people these constraints are always mediated by culture. Seaways which initially are a barrier to human expansion can change into highways of opportunity for groups that can develop an appropriate technological and cultural model. This thesis therefore explores the colonisation of Tawhiti Rahi, an island located in a sub-archipelago on the temperate north-east coast of New Zealand. It examines the specific biogeographical characteristics that made it an isolated and constrained natural environment, and then shows how these characteristics were informed and mediated by cultural mechanisms to become, in different ways and at different times, a place of value to local communities. The next section discusses how variation within island archipelagos can influence the course and nature of human colonisation.

2.0.2 Intra-Archipelago Variation

The above section 2.0.1 has shown that the human colonisation of islands occurred after mainlands because it required the development of maritime technologies and navigation skills to overcome the difficulties of access across seaways and to the constraints inherent in small circumscribed environments. Island archipelagos are defined in this thesis therefore as a relationship between islands and islands, and islands and mainlands within a cultural seascape. Within this conceptual framework this section looks at variation in island size, type and distribution within three archipelagos around the world, and how these can be both constraints and opportunities for human colonisation depending on cultural mediation.

The Cyclades islands in the Aegean sea consisted of a cluster of 2200 islands, islets and rocks however only 33 of the larger ones with harbours and agricultural potential remain inhabited to this day and form an archipelago around the sacred island of Delos. Located between modern day Greece and Turkey, island use began in the Neolithic around 13000 BP with importation of obsidian from Minos Island to the Greek mainland (Honea 1975). Over time they were probably used as a cross road and overnight stops for sailors in antiquity who only used line of site navigation. Cultural landscapes of land and seascapes formed around islands that were large enough to support permanent populations. By 3000 BP these coalesced into political alignments that encompassed both local and wider affiliations that rose and fell repeatedly. The key here was the importance of the seaway between islands and between the mainlands to the west and east that at various times provided communication advantages to the islanders (Broodbank 2000. Chapter 12).

Micronesia including the Caroline Islands contains over 600 scattered islands and covers 2.7million square kilometers of ocean, and is located to the north of the Solomon Islands and east of the Philippines. Settled by Austronesian speaking people about 4000 BP every island group developed distinctive languages that today are not mutually understood. Eastern Micronesia contains numerous low coral atoll islands and only three high islands of Kushrai, Pohnpei and Chuuk (formally Truk) and experiences consistent high rainfall. Small populations of 100-1000 people had generally only two social strata of chiefs and commoners. Primary food types varied as well with bananas, coconut, breadfruit, taro, and yams with the root crops like taro being gardened intensively on the limited land available. Western Micronesia on the other hand has continental land forms and contains mostly large volcanic high islands like Yap with seasonal rain and typhoons. High islands had up to four social strata with kings, high chiefs, low chiefs and commoners. Crops were similar but grown extensively on terraces however periodic droughts led to pandanus replaces breadfruit Unlike many Polynesian groups a number of the scattered atoll based societies maintained their ocean going maritime culture to tie together their small isolated communities into larger more sustainable conglomerations. On the typhoon islands adjacent to Yap atoll communities developed tribute relationships with communities on this high island for refuge during the hurricane season and to obtain large trees to make canoes (Cordy 1982; 1993). This canoe and navigation skill set remained well into the 20th century as was shown by Mao Piailug who led a revival of Polynesian navigating (Lewis 1978). For Micronesia then the seaways between islands were the key. For small islands seaways allowed chieftain based communities to function in the high risk atoll environments. For larger islands like Guam, Yap and Pohnpei seaways allowed them to become the equivalent of mainlands and where more centralised religious and economic center's such as Nan Madol were developed.

Early Polynesian arrivals to New Zealand colonised a giant archipelago extending north to south for over 1600km. Consisting of two large mainlands and hundreds of intervisible islands, islets and rocks scattered along the coast, and three non-intervisible island groups (Kermadecs, Chathams and Auckland islands), all show some evidence of Polynesian settlement (Anderson 2000; 2006). This variation in distance has led to the division of islands into inshore, offshore and outlier categories which often come in the form minor archipelagoes (Cochrane 1954; 1957). Culturally the outliers became isolated from mainland society and either developed their own social trajectory or settlement ended. Inshore islands are those places 0-3km from a mainland where the social costs of maritime access were no different from that found travelling along the mainland coast. As such the use of these inshore islands is hard to differentiate archaeologically from the mainland. It is only when offshore islands with their often higher social costs of maritime access are examined, that variation in size, topography and distribution within such sub-archipelagos becomes important.

This thesis looks at one such sub-archipelago that extends from the Northland mainland out to Great Barrier (Aotea) Island. Here a sheltered seaway encompasses large and small islands of variable topography and size, and an eclectic range or resources including garden soils, obsidian sources and seafood that Maori might utilise. Some localities like Great Barrier Island were so large it became a mainland in its own right. Others like the Mokohinau Islands were very small and had only a specialist limited use as a seasonal source of mutton birds and of obsidian. The island specifically studied is Tawhiti Rahi in the Poor Knights. Biogeographically isolated from the mainland for at least 3 million years, it offered to Maori conflicting dichotomies of rich gardening but little running water, and rich fisheries but very difficult access. The physical isolation and constraints found on this island, that might have limited or stopped human colonisation, were instead mediated through wider tribal cultural connections and contingencies enabling this island to become part of a cultural seaway and in a range of different ways, remain in use throughout prehistory.

2.1 Historical Knowledge

Historical Knowledge was the first approach used in my research. Written records and traditional and oral histories were collected from various sources and examined for information relevant to human occupation of the Poor Knights Island group. Strengths of this research approach lie in the fact that it is only with history that agency, in the sense of identifying individuals can occur. To a lesser extent understanding their political and social affiliations can be inferred and a commentary made on how these human actions can change over time. But research based on historical knowledge also has some weaknesses, the most significant being the diverse and incomplete nature of the historic record and the difficulty in substantiating the accuracy of particular records. Even when the accounts of certain events can be established through cross-referencing multiple sources, it can be difficult to interpret the significance of particular events when an overall chronological framework is not apparent. However, the differing strengths of the environmental science and archaeological research approaches work to balance these issues.

2.1.1 Historical Knowledge Methodology

The methodology chosen, while not comprehensive in scope, was tightly focused on the core questions and was designed to provide data that will inform the primary archaeological interpretation as synthesized in Chapter 6. Written records directly related to the Poor Knights Islands were extensively sampled, including journals and maps produced by the first European explorers, visitors on early ships, missionary accounts, early accounts of settlers and traders as well as more recent 20th century Native Land Court (NLC) accounts. However primary documents in Māori, such as the 1904 Papatupu Minute book for Te Roto, Great Barrier Island and Māori Land Block documents were not studied in relation to the wider area of Ngatiwai territory that extends from Northland's East Coast out to Great Barrier Island. Similarly, oral traditions about the Poor Knights Islands were collected only in an ad hoc way, often as a by-product of archaeological fieldwork along the Northland east coast, and consisted of opportunistic low key discussions with landowners and elders as well as more formal interviews with long-term key supporters of this research. Examples of the latter include Tohunga Whakairo Te Warihi Hetaraka and Rangatira HōriParata who were asked specific questions about Ngatiwai tribal history and the relationships between islands and the Northland mainland. It is acknowledged that a wider review of historical research in Ngatiwai's territory and a systematic program of collecting Ngatiwai oral traditions would be of value, however it is beyond the scope of this thesis.

The historic sources utilised for this thesis can be divided into written, traditional and oral history, however in reality there are significant overlaps that tend to blur the boundaries between these sources. For example, oral traditions when written by Māori can become traditional history (Piripi 1961). Similarly Europeans writing down indigenous oral accounts creates ethnography (Fraser 1925). Bearing in mind these sometimes unavoidable overlaps I have reviewed the historic record using the headings of Traditional History (Ethnography and Oral history) and History (Written). At the end of the history chapter (Chapter 3) the data is summarised and a synthesis made that sets out our understanding of Māori Settlement based on the overall historic record.

In summary the overall methodology for the historical knowledge chapter involved documenting the human history of the Poor Knights Islands within a broad chronological framework through a review of written, traditional, and oral history accounts associated with the islands. Next, a synthesis was made that: (i) looked for connections between diverse accounts to substantiate key events and (ii) looked for possible anomalies between and within accounts to suggest change over time. I theorise in my thesis that the historic approach should engage strongly with the 'who' question and to a lesser extent the 'why' and 'when' questions.

2.2 Environmental Science

Environmental science was the second research approach used in this thesis and it is set out in three component parts in ways similar to the approach taken in the historic chapter. Part I is a general review of published science that provides a broad overview of current knowledge about Tawhiti Rahi's geological history and the resulting distinctive topography, as well as it's biological uniqueness both terrestrial and maritime. Part II is new research that reconstructs the vegetation history of the island from a pollen core. Part III focuses on two oddities in the biology – namely the absence on the island group as a whole of the Polynesian commensal rat kiore, and the presence of the historically imported European pig only on one island within the Poor Knights group – Aorangi.

The strengths of the environmental science approach are that it can provide precise data that goes back to before the human history of New Zealand. Similarly the presence or absence of animals directly associated with Māori and European colonisation creates scenarios that can help us interpret both the timing and the nature of Māori settlement on Tawhiti Rahi and the other islands in the Poor Knights group. The weaknesses of the environmental science approach are primarily that anthropic actions can only be inferred indirectly. Again it is anticipated that the strengths of the historic and archaeological data will offset these draw backs.

2.2.1 Part I: Science Review

The Poor Knights have been a focus for scientific attention since the early years of the 20th century. Initially the focus was on the rare and distinctive endemic botanical and invertebrate species, however by the 1930s the geology of the islands was becoming of interest. Most recently the rich fisheries around the islands have been a major focus of research, and marine scientists played a significant role in successfully advocating for the waters around these islands to be protected as a marine reserve – just as earlier scientists led the push for the terrestrial environment to become a nature reserve.

The science review provides an overview of the island's geology, biology and marine sciences that is directly relevant to our understanding of the island's human history. For example, determining whether archaeologically recovered lithic material is locally or externally sourced engages with the themes of connectivity. Similarly, the recent expanding role of the Buller shearwater in the island's ecology engages with our understanding of this seabird's value to Māori as a seasonal food resource to be collected. Finally, gaining an understanding how the seasonal arrival of the East Australian current has created a uniquely rich marine environment containing tropical as well as temperate species directly relates to the archaeological analysis of a fishbone assemblage in Chapter 5 Part II.

The methodology chosen was to review the published scientific literature on the Poor Knights looking at geology, botany, biology and marine sciences. From this a summary was written outlining the island's volcanic origin and how this has shaped the island's topography, and how the island's isolation from the mainland has led to the appearance of an endemic flora and fauna. This then provides a base line of natural history information against which the human history - derived from the pollen study and the archaeology - can be compared and contrasted.

2.2.2 Part II: Pollen Study

A pollen analysis was conducted on sediment cores collected from the Poor Knights Islands in order to reconstruct the floral vegetative history of the islands. Pollen studies are usually undertaken to identify long sequences of vegetation change over time; however they are also of interest archaeologically as a means to interpret human interactions with their environment.

A key strength of pollen analysis is that it can capture a 'broad brush' picture reflecting what is going on within a catchment area and potentially over the whole island due to the wind born dispersal of pollen. Detailed study of a pollen core can also provide snippets of data that can be used to engage with the primary anthropological questions such as 'when' and 'why' these islands were settled. A weakness of the pollen analysis is that it acts only as a proxy for human settlement since the cultigens potentially grown on the Poor Knights Islands such as taro (*Colocasia esculenta*), kumara, also known as sweet potato (*Ipomoea batata*s), hue, also known as bottle gourd (*Lagenaria vulgaris*) and yam (*Dioscorea alata*) don't flower, or are harvested before flowering, and are therefore unlikely to be represented in the pollen sequence (Wilmshurst pers comm.2009). Instead pollen analysis can provide indirect evidence of human activities through dramatic shifts in pollen types from mature trees to first regeneration plants, and with the presence of significant charcoal spikes, both of which may be attributable to human land clearing.

This environmental science approach provides a narrow range of confirmable data about vegetation over a long time period. However it is only when the timeline of vegetative change is juxtaposed with the historical and archaeological data that the full benefits of this environmental science study will become apparent.

2.2.2.1 Pollen Coring; Separation; and Dating: Method and Program

Pollen samples are collected via controlled extraction of sediment cores taken from any locality where silts, charcoal and plant pollen can stratify over time. The core is first sectioned vertically, and then pollen is extracted using a standardised methodology. Following this the pollen is typed and counted. Finally, a pollen diagram showing change in type and quantity of pollen over time is then created. Pollen and charcoal from points of vegetative change may undergo radiocarbon dating to allow for further interpretation of the pollen sequence with regard to humans as the agents of change. Due to the specialist nature of pollen studies, the fieldwork and subsequent laboratory analysis for this investigation was carried out in partnership with Dr Janet Wilmshurst of Landcare Research New Zealand.

Attempts were made to collect sediment cores for pollen analysis from saturated locations on both Aorangi and Tawhiti Rahi Islands. Due to the difficulty of access and lack of any infrastructure on this highly protected island, a mechanical 'vibra corer' could not be used. Instead, a hand driven 50 cm D-section corer was used to extract cores. Samples for pollen analysis were taken every 2cm of the sediments. These samples were prepared for pollen analyses following standard acetylation and hydrofluoric acid procedures (Faegri and Iverson 1989). Pollen counting proceeded until a sum of at least 250 pollen grains from tall trees, small trees and dry land herbs had been counted. The native dry land herb brackenfern (*Pteridium*) was included in the count since bracken spores are generally widely dispersed (McGlone 1982; McGlone et al.,2005). The software packages TILIA and TILIAGRAPH (E. Grimm, Illinois State Museum, Springfield, Illinois) were used to construct the pollen diagrams. Zonation was based on the divisions defined by CONISS, which is included in the TILIA software package. To convert the pollen sequence into calendar dates a series of radiocarbon dates were acquired from sediments taken from successfully extracted cores. Dating was carried out by the Waikato Radiocarbon laboratory. Once the vegetation sequence was established from the pollen then bulk charcoal samples were taken from key vegetation change points.

Once completed this reconstruction of a detailed and calendar dated vegetation sequence was discussed with regard to the primary archaeological questions concerning the timing and nature of human settlement on Tawhiti Rahi Island.

2.2.3 Part III: Presence and Absence Scenarios

Within the Poor Knights island group the presence of European pigs on Aorangi but not Tawhiti Rahi, and the absence of the Polynesian rat, thekiore, from both islands, has clear implications about both the timing and the nature of Māori settlement on these islands.

2.2.3.1 *Absence of Rats*

A narrowly focused literature review looked at the timing and spread of kiore in New Zealand that is associated with initial Polynesian settlement, and what is known about their presence or absence on offshore islands around the New Zealand coast. Upon identification of rat free islands, an assessment of these island's physical characteristics was made to determine if there are any environmental reasons why kiore did not establish themselves there. A further assessment was then made of the known archaeology and history of the rat free islands to determine if the timing or nature of Māori settlement was instrumental in kiore not becoming established.

2.2.3.2 *Presence of Pigs*

A narrowly focused review was made of the European pig and how its role in Māori subsistence in Northland developed in the early historic period. Specifically this attempted to determine when pigs were introduced and became established in Northland.

In summary, the three part approach to the Poor Knights Island's environmental history provides a base line of information about the present day environment against which the reconstructed vegetation history can be compared. The environmental science approach required sediment core sampling, followed by pollen analysis and radiocarbon dating, allowing for construction of a pollen diagram showing a floral history of the Poor Knights Islands. This vegetative history can be used on its own to directly suggest when people first arrived on these islands and how long they stayed (when question). However, when this vegetation change is integrated with our historic and archaeological understanding of human presence on the island, it can also be used to suggest the nature of island settlement and how it might have changed over time (why question).

Against the backdrop of this reconstructed vegetation history on Tawhiti Rahi, the presence and absence scenarios associated with the introduced species of kiore and pig provide data that is then incorporated into the archaeological interpretation of how, why and when this island was settled.

2.3 Archaeology

Archaeological Research was by far the largest and most comprehensive research component used in this thesis, and is the primary focus of this study. Comprehensive survey and mapping, focused excavation, and artifact analysis were undertaken on Tawhiti Rahi in order to interpret physical evidence left behind by the island's human inhabitants.

The strength of this approach is that archaeology provides the framework into which the other two approaches are interwoven. It provides direct and very detailed spatial evidence of what the islanders were actuallydoing both on Tawhiti Rahi, between this island and the other islands and between this island and the Northland mainland in both the recent and distant past. In practical terms, any interpretation of the island's history must incorporate a number of 'fixed points' of knowledge that comes from this archaeological research. Commonly, these points relate to patterns of land use and modification, the presence or absence of structures or artefacts, and to site specific chronologies identified from C14 radiometric dating of stratigraphic deposits.

The weaknesses of the archaeological approach includes the inability to identify individuals, the difficulty in interpreting landscapes over time when the sequence of construction of elements within it is unclear, and the danger of being mislead by extrapolating island chronologies from only a few site specific chronologies. It is for these reasons that my interpretation of the human history of Tawhiti Rahi Island is based on 'reading' archaeology through a lense of history and environmental science research. In this context, the strengths of both the historic research and environmental science approaches will work to off-set the limitations of a purely archaeological analysis when a synthesis of the island's human history is made in Chapter 6.

Within the guiding framework of 'who', 'why' and 'when' questions about human settlement discussed above, the archaeology research methodology for Tawhiti Rahi Island has been divided into three parts. Part one sets out methodology for the detailed mapping of archaeological structures and artefacts across the island landscape; part two describes the methodology for a series of small and tightly focused excavations on five representative sites; part three sets out how the portable material culture identified during the survey and excavations were analysed.

2.3.1 Part 1: (A Comprehensive Island Survey)

During previous visits to the Poor Knights Islands as part of the Department of Conservation inventory program, difficulties in conducting a technical survey had been identified. Like Aorangi Island, Tawhiti Rahi contains extensive 'areas' of archaeological sites, however surveying these are difficult because there are often no clear boundaries between areas of feature concentrations. In addition, many of the concentrations are located on the high plateau to the north that lacks distinct topographical features that could be used as reference points for surveying. A final difficulty is that all the sites are situated under a continuous canopy of podocarp forest that restricts visibility to less than 20m.

As will be discussed in detail in Chapter Five, previous archaeological surveys had recorded 25 sites on Tawhiti Rahi Island (Haywood 1983; Lawlor unpublished 1988). Apart from three site plans and two overview plans made by Haywood and Lawlor, and the 1:5000 overview plans made by Robinson (Robinson 2004; App 1-4), the complex archaeological landscape still needed to be recorded. Rather than engaging in the international debate on how sites are defined or whether they even exist at all (Binford 1982, and many others) it was decided that this survey would record at the more detailed feature/artefact level. At this fine scale, a survey basically records the presence or absence of artefacts and structural elements across the landscape. The large number of such elements requires a classificatory-descriptive approach to identify and manage the data. Quantitative analysis is beyond the scope of this doctoral research but is planned to be addressed in subsequent papers.

2.3.1.1 Detailed Site Drawing

Step one:

The 1:50,000 NZMS 260 metric map sheet R06 that shows the Poor Knights Islands, was enlarged to 1:10,000 scale and a 100 m grid overlaid. To create a primary survey baseline Geographical positioning System (GPS) readings of each of the 136 numbered tags on the existing primary north-south track were taken and plotted onto this map. Since secondary baselines were also needed across the wider parts of the island, four new wing tracks (identified as A, B, C, D) were laid out at two places east and west of the primary track at track marker 90 and 136. To increase the accuracy of this part of the survey, a differentially corrected Trimble GPS machine with an accuracy of + or – 1 m was used.

Step two:

Before detailed field recording began, a broad assessment of the whole island was made, based on the 2001 understanding of site distribution (Figure 2.1). This activity required traversing the topography and plotting the main concentrations of features on to a plan which used the same 1:10,000 enlargement of sheet R06 and was completed using a hand held Garmin 2+ GPS unit to plot each primary cluster of features with a 15m+- accuracy. Features were identified using the New Zealand Archaeological Association archaeological survey handbook (Daniels: 1970) and the typology of stone structures noted by Lawlor from his Aorangi Island fieldwork in the 1970s (Lawlor 1979). Artefacts as well as faunal material found on the surface were bagged, labelled, GPS grid referenced and uplifted. Where large quantities of material were found, such as in obsidian work floors, representative sampling was undertaken.

The survey team then used plastic film-covered drawing boards with 10 cm grids and marked with the appropriate NZMS 260 R06 map sheet easting's and northing's, to draw up features at the 1:200 and 1:400 scale, depending on the complexity of features identified. When a survey team located an area of features, 100 m long tape measure baselines 20 m apart were laid out over the area. Then, using tertiary tapes, hand tapes and compass, the archaeological features were drawn onto the drawing board. Once a plan was completed, the corners of the map were located using the Garmin 2+GPS unit. Since GPS has been shown to not work reliably under vegetation, a wire connected auxiliary aerial mounted on a 7.5 m extendable pole was used to penetrate the canopy and enable accurate readings to be taken. Because of the vertical displacement the height data was not used in this study. By the time the last field trips were made in 2008 the Garmin 2+ unit was replaced with the Garmin 60Csx. This machine utilised a more sensitive antennae and could work under canopy without requiring external aerials or extension poles.

Accepting a GPS machine accuracy error of +-5 m for the hand held Garmin GPS unit gives a real world error of +-15 m. This lack of precision is acceptable because it avoids any cumulative error often associated with dead reckoning surveys. The resulting artifact data, field sketches and field maps were entered into an ArchView 9.3 Geographic Information System (GIS) program and then digitized using a range of feature polygons and artefact point data. This mapping exercise and subsequent GIS analysis were undertaken in order to quantify our subjective view that the island's landscape of archaeology is extensive and often continuous. In many instances gardening areas can be seen to merge into habitation areas and back again, with no clear boundary. Therefore it is only through such GIS analysis that component parts of this complex landscape can be identified.

2.3.2 Part 2: (Set of Focused Excavations)

Survey results on Tawhiti Rahi indicate the presence of different site types. For the purposes of this research these have been divided habitation, gardening, functional specialistand ceremonial. A series of small, tightly focused excavations of each of these site types were undertaken in order to investigate stone features (mounds and row); terraces (garden and occupation); pit features (food storage) and the cave site. Detailed surface plans of each site were made prior to excavation. The purpose of these excavations was to confirm site function and to obtain material for radiometric dating.

The main threat to the archaeological sites on Tawhiti Rahi is the burrowing Buller Shearwater seabird. Since human occupation ended in 1823, these birds have re-colonised the island and

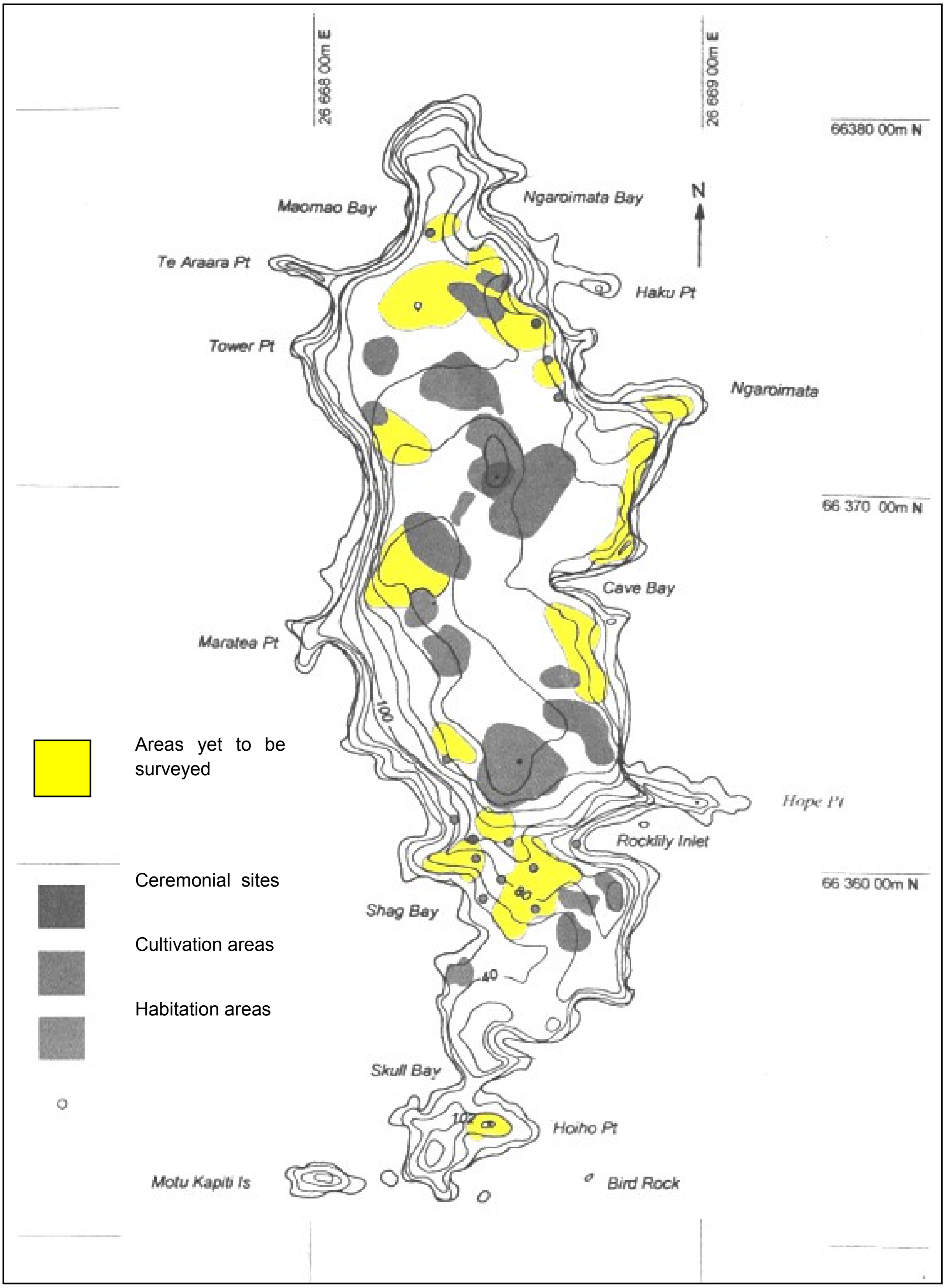

Figure 2.1 Areas on Tawhiti Rahi known to contain, and suspected of containing archaeological features, as of 2001.

have shown a marked preference for constructing their underground nests in areas cleared of stone by the former Māori inhabitants. Therefore wherever possible, the sites chosen for investigation are under threat of, or have already been modified by these sea birds, allowing for collection of archaeological information before it becomes irretrievably lost

Excavation objectives were conducted through traditional excavation techniques. The chosen sites were cleared of vegetation and baselines pegged out. Excavation proceeded using either 50 x 50cm or 1 by 1 square meter areas and followed standard stratigraphic methodology. Site plans and profiles were drawn, and soil samples and artefacts collected and numbered to square and stratigraphic level. In collecting samples for radiocarbon dating, particular attention was paid to using samples with limited inbuilt age factors, such as twiggy material and/or short lived species (Waikato radiocarbon laboratory 2015). In addition, all samples collected for dating were immediately wrapped in aluminium foil and placed in sealed containers, so as to minimisethe possibility of modern carbon contamination.

2.3.3 Part III: (Portable Material Culture Analysis)

Part 3 discusses the extensive distribution of portable material culture that includes lithics, flora and fauna, but excluding human remains. Some of this was obtained from the excavations but most were found as surface deposits that in varying concentrations overlie both the archaeological earth and stonework features and areas without any such obvious features. This material forms a data set in its own right and is analysed in a number of ways under the three headings of lithics, flora and fauna.

<u>Lithics</u>

Previous surveys had noted a range of imported lithics on Tawhiti Rahi, including water rolled basalt boulders, red ochre, adzes of basalt and gabbro, chert and obsidian. Protocol for the current survey consisted of complete collection of all lithics except obsidian. Lithic material was photographed, bagged, labeled, GPS grid referenced, and uplifted. All material was then entered into the GIS ArchMap program as point data with appropriate fields. Material recorded in note books from previous expeditions to the island was also entered into the GIS program.

Obsidian was however treated differently because it is by far the most common artefact found on the island. Making up 95% of the lithic artefacts present on Tawhiti Rahi, it is widely distributed across the island as isolates, scatters and concentrations. Also, unlike the other lithics, obsidian has a limited range of source locations. Therefore individual artefacts were identified to known sources through a physical characteristics study, and geochemical analysis that used X-Ray

Fluorescence (XRF) analysis. Notes about obsidian were collected on the Poor Knights between 1999 and 2001 as part of ongoing island management,were also entered into the GIS program. Obsidian collection was undertaken during both the survey and the excavation phases of this thesis research. In an identical protocol to other lithic material, all isolates and small scatters of obsidian were total sampled. In contrast obsidian found in two of three large concentrations was representatively sampled using a cross grid of 50cm squares running north-south and east-west. The third large concentration of obsidian was sampled as part of an excavation process. All artefacts found within these squares were photographed, bagged, labeled, GPS grid referenced per numbered square and then uplifted. Once collected the following analysis methodology was followed.

1. All material was entered into the GIS program as point data.
2. Physical characteristics analysis was made.
3. Geochemical analysis using XRF was made of a representative sample to identify to source.
4. Inter and intra-site distribution on Tawhiti Rahi was interpreted.

Flora

This small category totals 82 samples that have been subdivided into artifacts, by products of cultural action, charcoal and wood, and seeds. Material located during excavations has been photographed, bagged, labeled, grid referenced within a site, and uplifted. Materials encountered on the floor of the cave (R06-17) or during the survey of the island were photographed and grid referenced or GPS to site, but left in situ. All material records were then entered into the GIS ArchMap program as point data with appropriate fields.

Fauna

This large category consists of shellfish and non-human bone. Shell fish were subdivided into marine rocky shore species, marine sandy shore species and terrestrial species. Material located during excavations has been photographed, bagged, labeled, grid referenced within a site, and uplifted. Material encountered on the floor of the cave (R06-17) was photographed and grid referenced within the site, but left in situ. Material encountered during the island survey of 2005 to 2008 were photographed, GPS referenced and collected, however material noted field books from earlier surveys between 1999-2001 was not collected but descriptive and location information were used. Identification to species was determined using the comparative collection of the Department of Anthropology and Archaeology, University of Otago. All material records were then entered into the GIS ArchMap program as point data with appropriate fields.

Non-human bone consisted predominantly of fishbone with a limited amount of mammal, bird and reptile. It was found in some of the excavations, and on the ground surface during the survey, where it commonly clustered in small middens generally alongside fishbone. All such material was collected, bagged and GPS referenced. Identification of the bone from six representative sites was carried out by specialists and the results included in Appendix 7i and 7ii. All material records were then entered into the GIS ArchMap program as point data with appropriate fields.

In summary, the archaeological research methodology applied on Tawhiti Rahi consisted of comprehensive survey using GPS technology in a difficult field setting, focused excavation of a variety of site types found on the island, and the analysis of the rich legacy of portable material culture evidence left behind by the island's former inhabitants. The archaeology research engages directly with our understanding of 'why' this island was settled by looking at site function. It also gives some idea of 'who' settled it by looking at inter-community connections including trade and exchange that were identified by faunal as well as lithic sourcing studies. Engagement with the 'when' question occurs directly through carbon dates generated from the excavations. Indirectly the 'presence or absence' of certain obsidian sources may give some indication of broadly 'when' the Poor Knights Islands were used.

2.3.4 Part IV: (Human remains)

Human remains are a special category and need to be treated ethically and with the consent of descendant groups. Protocols for their identifying, recording and locating were established with Ngatiwai Trust Board and senior Rangatira (chiefs) and Tohunga (expert practitioners). All material encountered during the survey and excavations was not removed or uplifted. Rather each item that was identified as human was recorded using GPS and entered into the GIS as point data. All such records are held by the Ngatiwai Trust Board.

In summary, identifying koiwi found in formal burials engages with the question of whether Māorisettlement was permanent or intermittent, while koiwi found as scattered bones gives insight into the reported attack in early historic times that depopulated the island.

This thesis research will now begin with Chapter 3 - historical research.

Chapter 3: Historical Knowledge

3.0 Introduction

As the first part of the multidisciplinary approach used in this thesis, this chapter will examine the ethnographic, historic, and oral accounts that relate to the history of human settlement on the Poor Knight Islands. Each of these sources provides information into the prehistoric Māori settlement that is reflected in the extensive archaeological landscape on the island which abruptly ended early in the historic period. This chapter is set out in three parts. The first part discusses the traditional history while the second part looks at the published history. Part three synthesizes the information we have available and proposes a possible historically sourced history of the islands.

3.1 Traditional History (Ethnography and Oral history)

3.1.1 Māori Historical Context of the North-east Coast of Northland

Ngatiwai are an ancient people who were known as Ngatiwai ki Moana (those who lived along the east coast and offshore islands) and Ngatiwai ki te tua Whenua (those who lived inland). Ngatiwai descend from the tribe Ngati Manaia who arrived on the canoe Mahuhu-Ki-Te-Rangi and the founding ancestors are Manaia, Tamatea and Tahuhunuioterangi. The mana of Ngatiwai is water and this is remembered by Manaia saying to his descendants, "Although you stand on land, you stand also in the sea" (Department of Conservation web site 18/05/2012). Ngatiwai occupies the shoreline from Rakau Maungamaunga (Cape Brett) in the North West, to Tawharanui (Cape Rodney) and Matakana in the South. The eastern boundaries of the Iwi (tribe);

> '..consist of the many offshore islands that lie in the sea known to us as Te Moana nui o Toi te Huatahi [The sea of Toi te Huatahi]'. (McMath 1995:9)

The many motu (islands) within this sea are known collectively as 'Nga Poito o te Kupenga o Toi te Huatahi" [the floats of the fishing net of Toi te Huatahi]. The largest of these include Aorangi and Tawhiti Rahi (Poor Knights Islands), Taranga and Motukino (Hen and Chickens Islands), Pokohinau and Motukino (Mokohinau Islands), and, to the south, Te Hauturu o Toi (Little Barrier), and the largest of all, Aotea (Great Barrier Island) (McMath 1995:9-10);

> 'We of Ngatiwai are a coastal and seagoing Iwi. We have travelled up and down the chain of islands from Aorangi and Tawhiti Rahi to Aotea for centuries….Our seagoing tradition,

and the oceans and islands that make up a significant part of our tribal rohe, provides one of the origins of our tribal name of Ngatiwai'. (McMath 1995:10)

Te Morore Kaupeka Piripi, a rangatira (chief) of Ngatiwai living at Punaruku on the Northland coast, stated that;

"Ko nga mana katoa o Ngatiwai kei te wa, i nga taniwha mo ratou Manawa" [All the mana of Ngatiwai comes from the sea, from its guardian taniwha and their spiritual force]. (McMath 1995:10)

Former Chairman of the Ngatiwai Trust Board Witi McMath gave evidence at a 1995 Māori Land Court hearing concerning the title of offshore islands around Aotea (Great Barrier). As part of his evidence McMath notes that Ngati Manaia had ancient links to Aotea (Great Barrier Island) through people called Ngati Te Rauwawa, who under Rangatira Pukehinau who moved back and forth from the island to the mainland. In the late 1600s Te Kawerau (to the south) and Ngati Manaia (to the north) who were long term neighbours along the Northland coast, fought a battle at Mahurangi. Although losing to Te Kawerau subsequent marriages to ensure peace led to appearance of Ngati Wai (McMath 1995:5).By the early 18th century Ngatiwai as a group was emerging as a power in the region. With a rapidly increasing population and the resulting overcrowding of mainland settlements, it is not surprising that;

"The Ngatiwai hapu occupying the coastline between Mahurangi and the Bay of Islands maintained permanent occupation and resource use of the many offshore islands between Aorangi and Tawhiti Rahi (The Poor Knights) and Hauturu and Aotea". (McMath 1995:23)

Along this coastline Ngatiwai territory overlapped with the large tribal groupings of Ngati Whatua in the south and Ngapuhi in the north. Numerous authors have discussed the tribal situation in Northland that saw the various hapu of Ngapuhi expanding into the Bay of Islands in the 18th century (Lee 1996, Ballara 1996, Sissons et al 1987, Belich 1996 and many others). Broadly speaking there were three political groupings in the Bay that are referred to here as the northern, western and southern alliance of Ngapuhi (Sissons et al 1987; Belich 1996). Belich and others have argued that each was in competition over 'mana' and that the escalation of conflict with other Iwi was also aimed at increasing both individual and collective mana. Their competing attempts from the late 18th century to control European trade with the whaling fleets and through the missionary settlements can be seen as a further reflection of this overriding goal. One interpretation of the Māori world view at the time of European contact was that for any member of a hapu (sub-tribe), all other people were either, relations, neighbours or enemies. Therefore gaining mana through direct conflict between closely related groups such as the three Ngapuhi alliances was limited due to the close family ties between them and the likely prospect of retribution (utu) occurring. However neighbours of such related groups often lacked these close ties and so were fair game for attack. Within this framework Ngatiwai in the 18th century were located to the south of the Bay of Islands, and were neighbours and close relations to Iwi of Te Parawhau in Whangārei and Ngare Raumati in the Bay of Islands. In the early nineteenth century Ngatiwai had connections with all three Ngapuhi alliances, but the strongest relationship by far was with the southern Ngapuhi, who were led by Ngati Manu rangatira (chief) Pomare I who was close kin to Ngatiwai through Ngati Manaia descent (McMath 1996:28). Kin relations with Pomare's people provided both protection and opportunities for advancing Ngatiwai mana; however it left them vulnerable to attack by the other Ngapuhi alliances. Despite this the Ngatiwai Whanui (family) remained a force to be reckoned with as their number included the hapu of Ngati Rehua, Te Uri o Hikihiki, Te Akitai, Te Patuharakeke, Ngati Manuhiri and Te Waiariki (McMath 1995:35).

3.1.2 Poor Knights Traditional History and Ethnography

The first published account of Ngatiwai history by Māori was written by Morore Piripi in 1961. When focusing on the Poor Knights Islands, Piripi (of chiefly lineage from the Whangaruru area) related that the first ancestors of Ngatiwai were Manaia and Puhikaiariki (also known as Puhimoanariki and Puhi). Puhikaiarikitravelled along the Northland coastline in the canoe Matātua. The object of his travelling was to survey the land to find a good place in which to settle himself and his people and in doing so he named many of the features along the coast, including 'Tawhitirangi and Aorangi' [Tawhiti Rahi and Aorangi] which reminded him of the islands in his homeland(Piripi 1962a:46). Piripi also noted that among the places Manaia stayed along Northlands coast were "Mimiwhangata, Whangaruru and 'Tawhiti Rahiri' [Tawhiti Rahi] that were known to the Europeans as the Poor Knights Islands" (Piripi 1961:19).

More recent Māori documentation from traditional sources about the Poor Knights islands is rare. The most detailed information comes from the Patuone whakapapa or tatai (genealogical) web site. This site noted that there were wide linkages between rangatira line families in Te Tai Tokerau (Northland). It refers to the Poor Knights group of islands as Tawhitinui and states that its main islands are Tawhiti Rahi and Aorangi. Te Tatua was identified as a rangatira of Ngatiwai and Ngati Toki who lived with his people on the islands of Tawhitinui. His wife Te Oneho is the daughter of Te Taotahi and Te Ao-Hei-Awa, and the web site administrator provides a tātai(genealogy) that shows she is a direct descendant of the rangatira Nehe through Motatatau and Te Kamo. Presumably from the administrator's general knowledge, the famous story of the attack on the Poor Knights in 1820 is recounted. In it, Te Hikutu is identified as the attackers who were responding to an alleged insult to rangatira Waikato from rangatira Te Tatua. It confirms that Te Tatua was away fighting with Hongi Hika in 1820 and that Te Oneho was captured but escaped while in the Whangaroa harbour through the assistance of relatives (Pittman 2013:1). Since the administrator argues that Te Taotahi was born circa 1750 and that his daughter Te Oneho was his fourth child after Nehe (named after his grandfather), Whakāriki and Te Korehu, it is argued here she would have been approximately 30-50 years old at the time of the attack in 1823 (Pittman 2013:2).

William Fraser wrote the first European published account in 1925. This ethnography of the Poor Knights Islands was based on accounts by Ngatiwai living on the coast adjacent to the islands about 100 years after they were abandoned. Fraser's informants confirmed Piripi's account of the naming of the islands and added that the larger northern island Tawhiti Rahi was inhabited by a hapu called Ngatiwai led by rangatira Tuaho. The smaller southern island Aorangi was inhabited by the Ngati Toko hapu whose rangatira was Te Tatua. In total around 300 to 400 people are reputed to have lived on Tawhiti Rahi for many generations gardening and harvesting the rako, the local Māori name for the Buller Shearwater (*Puffinus bulleri*) as a mutton-bird. The Poor Knights were not self-sufficient in that worked and carved totara was not locally available and must have been imported (Fraser 1925:8). Fraser further documented that pigs obtained from Captain Cook were being raised on Aorangi in the early historic period, most likely to be used in trade for European goods and later guns. While Te Tatua and his men were away in the south fighting alongside the Ngapuhi rangatira Hongi Hika, issues over access to these pigs were a factor in an attack by Te Hikutu [a hapu of Nga Puhi based in part at Rangihoua in the northern Bay of Islands], sometime after 1808 (Fraser 1925:8).

Specific and detailed traditional information about the Poor Knights was given at a New Zealand Native Land Court (NLC) hearing of 1928 which highlighted some fundamental inaccuracies in Frasers account. At this sitting Hana Paengatai aged 97, gave evidence about the island's history and ownership (Appendix 1). She stated that Te Tatua was the rangatira (chief) who claimed Tawhiti Rahi, and that he was the first and last chief to live there, and his hapu affiliations were to Ngatimanaia, Ngatiwai and Patutahi. Hana also reported that the other people who lived on the islands were the Ngati Toki hapu, who occupied Aorangi Island, and Tuaho was their rangatira (Native Land Court 1928:251). Talking about Tawhiti Rahi, Hana stated to the court that;

> "There were no inhabitants of the island before Te Tatua's time, so he went there and occupied it. His Tupuna Panoa went there first. This was before the coming of the white man". (Native Land Court 1928: 249)

Hana Paengatai's association of Te Tatua with Tawhiti Rahi and Tuaho with Aorangi differed from Fraser's published account. When Fraser was cross examined on this by the crown prosecutor he accepted that his recollection was wrong and that Hana's account was correct (NLC 1928:259). Hana then went on to identify the Te Hikutu people of the Hokianga as the attackers of both Aorangi and Tawhiti Rahi Islands (NLC 1928:247, 250). Waikato, who was a rangatira of Te Hikutu, refused to be involved in the attack due to family connections with people on Tawhiti Rahi, but others led by Whare Pouaka and Tura attacked the islands while Te Tatua and his warriors were away fighting in the Hauraki Gulf with Pomare and Hongi Hika (NLC 1928:247) Recent research suggests that the Te Hikutu attack originated, at least in part, from the Bay of Islands since a number of Te Hikutu including Waikato and Te Whare Pouaka had moved from the Hokianga to live at Rangihoua and Te Puna in the Bay of Islands in the 1820s and 1830s (Binney 2007:318). It is argued that the attack occurred in 1823 (Devonshire in Northern Advocate 12/01/1972).

Hana confirmed the well-known story recounted by Fraser of the slave Omano saving Te Tatua's son Hōri Wehiwehi (Plate 3.1) during the attack by sheltering him in a cave, but clarified that this occurred on Tawhiti Rahi not Aorangi. On his return to the islands Te Tatua collected the bodies of the slain and sent them back in two canoes to the mainland for burial at Roimata Pt on the Tutukaka coast (NLC 1928:252). The survivors were taken to Rawhiti in the Bay of Islands, and other places along the Taitokerau (Northland) coast (NLC 1928:248).

In a further statement to the court, Hana Paengatai stated that;

> "I saw Te Tatua he was well tattooed. I was told that both Tawhiti Rahi and Aorangi were full of people before the massacre took place. After the attack the whole place smelt of the dead. I heard that 40 men went south with Te Tatua *[in a war party]* there must have been 50 or more left on the island because the dead lay all over the place" (NLC 1928: 251-2).

Hana concluded by saying that since these events, Māori have repeatedly gone to Tawhiti Rahi on fishing excursions, but the island being tapu, they kept to the beaches and did not enter the island.

From the late 1980s, human bones had been observed by Department of Conservation staff on Aorangi Island. These were clearly not burials and it was assumed that they were casualties from the 1823 attack. Rangatira Hōri Parata was responsible for the uplifting of these koiwi and their subsequent burial at Matapouri on the Northland coast alongside Ngatitoki from Aorangi buried there immediately after the battle. Rangatira Parata stated that he did not uplift koiwi from Tawhiti Rahi (H. Parata pers. comm., 2008).

Plate 3.1 A photograph of Hōri Wehiwehi, the son of rangatira Te Tatua and Te Oneho. This photograph is likely to have been taken circa 1860. [Photograph provided courtesy of Charlotte Pita]

3.1.3 Oral Traditions of Regional Connections

The concept of a Ngatiwai seaway between the central Northland east coast out to Aotea (Great Barrier Island) is well understood (Tatton 1994, Murdoch 2007, Peterson pers. comm., 2006, Stone pers. comm., 2008). References directly to the Poor Knights within this seaway are scarce and fragmentary but there is some oral history.

In the late 1600s a Ngati Manaia ope (group) led by rangatira Te Whaiti went from Mimiwhangata to the north-west coast of Aotea. Subsequent marriages and conflict with various groups resident there eventually led to Ngati Manaia controlling this island and took the name Ngati Rehua (McMath 1995, 5-7).

After Aotea was finally conquered (late 1700s?);

> The Ngatiwai hapu occupying the coastline between Mahurangi and the Bay of Islands maintained permanent occupation and resource use of the many offshore islands between Aorangi and Tawhiti Rahi (The Poor Knights) and Hauturu [little Barrier] and Aotea [Great Barrier]". (McMath 1995:23)

And;

> Rangihokaia and Hikihiki maintained their major pa at Mimiwhangata and Whangaruru. At this time Ngatiwai was emerging as a powerful force. Their numbers were growing rapidly and their pa and kainga were becoming overcrowded. For this reason Ngatiwai regularly visited the many motu [islands] that lay within the Ngatiwai rohe [territory], including Aotea" (McMath 1995, 24).

It is at this time or later that an undated battle event occurred at Mimiwhangata on the coast immediately opposite the Poor Knights Islands. Here Ngatiwai forces were defeated by Ngapuhi and dispersed (Piripi 1961:21; Piripi 1962a:43-45; Slocombe 1994:3-4) and this event maybe associated with a migration/retreat of Ngatiwai from the mainland out to Aotea recorded in the 1820s (McKinnon 1997:plate 29). It is possible that Tohunga Whakairo Te Warihi Hetaraka's account that people, 'moved to the islands' following a battle on the mainland refers to one or both of these events (Te Warihi Hetaraka pers. comm., 2006). It is speculated that circumscriptions in the form of difficult access and limited fresh water may have limited the innitial use of islands like Taranga and Marotiri (Hen and Chickens), and the Poor Knights to being only garden outlier for people resided elsewhere. Late in prehistory these access circumscriptions were re-interpreted as an asset rather than a liability when people's needs for defense became increasingly important since the whole island could now be treated as a natural defendable pa (Te Warihi Hetaraka pers. comm., 2001). If correct then the first establishment of a resident population on these islands is likely to have occurred at this time.

To the present day local Ngatiwai at Whakapaumahara Marae at Whananaki consider Ngati Rehua on Aotea to be the same people as them(Ngawaka pers. comm., 2006). Important connections between this part of Whananaki and Tawhiti Rahi in the Poor Knights include two locations less than 2 km apart. The first are adjacent pit and terrace sites behind Tauwhana Bay

(NZAA sites Q06-40 & Q06-53). The current landowner was told in the 1970s by local people that these pits belonged to the Poor Knights Islanders (Meredith pers. comm. 2006). The second is at Roimata Pt in Rockells Bay, where Te Tatua buried his people killed during the attack on Tawhiti Rahi (NLC 1928:252). Connections also exist with Whangaruru Harbour. At the important Whakaturia Pa located in the Harbour, a wahi tapu (burial) area is located in the dunes on its northern flank. In 1978 the teacher there was informed by local Māori that this was a burial area containing bodies of locals killed following an attack by people from the Poor Knights (NZAA site record form Q05/641).

A possible relic of proto-historic interactions of closely related kin groups may be seen in the regular movement of labour associated with horticulture, when Ngati Rehua from Aotea annually visited Whangaruru harbour on the adjacent east coast of Northland. As a seasonal gardening event this saw planting of kumara and potatoes at Kirikiri at Whangaruru North Head) in March-April and a return for harvesting in October–November. This practice only stopped in the 1920s although some argue it continued up to 1947 (Ngawaka, pers. comm., 2006; Martin, pers. comm., 2006; Davis pers. comm., 2006). In the 1980s a party retraced this route using kayaks (Stone pers. comm., 2008). It is not unreasonable to believe that similar labour intensive activities associated with horticulture occurred between other kinship groups located on the mainland and other offshore island groups. This style of horticultural management would work with non-resident seasonal visitation and with permanent settlement.

3.1.4 Traditional History Summary

In summary, a range of traditional history records suggests that the initial discovery and naming of the Poor Knights Islands dates back to founding ancestors and is likely to have occurred soon after initial arrival of Polynesian migrants to New Zealand. It is unclear what use was made of the islands at this time, but it is probable that the rich fisheries and abundant mutton-birds would have been seasonally exploited. Whether horticulture occurred in this early period is not discussed in the traditional records. However Hana Paengatai's testimony in 1928 suggests that there was a period of intense island settlement that occurred just prior to European arrival. Her emphasis on the fact that the island was uninhabited prior to Rangatira Te Tatua's tupuna (ancestor) Panoa moving there, and that Te Tatua was the first and only chief to live on Tawhiti Rahi Island, suggests that the complex archaeological landscape of this late period settlement is unlikely to predate 1700. The marriage of Te Tatua and Te Oneho connected important families at Whananaki and Takahiwai. Since the Tatai record for Te Tatua's wife Te Oneho indicates that her father Te Taotahi was born circa 1750, and using a minimum 15 year generational gap, the earliest she could have married Te Tatua is 1780. Working backwards from the attack in 1823 when her only son Hōri Wehiwehi, who had been born on the island and was still a boy (10 years old or less), (see Appendix 1), it is unlikely that she could have married Te Tatua after 1813. Assuming that the component parts of the archaeological landscape visible today reflect settlement associated with this firstpresence of a chief on this island, the inhabitants would have had - at most - only 43 years to construct it. If these back-calculations are correct, it may be speculated that following a military defeat at the hands of Ngapuhi on the adjacent mainland coastal site of Mimiwhangata, Tawhiti Rahi Island experienced a single, coordinated and planned occupation event that was part of a retreat/migration of a Ngatiwai kin group from Whananaki area (only 5 km south of Mimiwhangata) to the offshore islands in the late 1700s.

3.2 History (Written Accounts)

3.2.1 Records During Māori Occupation 1769-1823

Only 54 years lie between first significant European contact with Māori in 1769 and the ending of Māori settlement on the Poor Knights in 1823. Lying within the little documented proto-historic period of New Zealand's recent past it is understandable thatthere are few references about these islands and Māori settlement on them in the historic literature. What is known is that the first Europeans to see this island group were on Captain James Cook's first voyage to New Zealand on the barque 'Endeavour' in 1769.

3.2.1.1 Accounts from the Endeavour

On November 25th 1769 HMS Endeavour sailed past the Poor Knights Islands at a distance of 12 miles on its way north to the Bay of Islands. On this day Cook noted that;

> "At Noon our Latitude by observation was 36 degrees 36 minutes s. Bream Head bore south distant 10 Miles, some small Islands (Poor Knights) at NEBN distant 3 Leags and the northernmost land in sight bore NNW, being at this time 2 Miles from the shore and in this situation had 26 fathom water. The land hearabouts is rather low and pretty well cover'd with wood and seems not ill inhabited.
>
> SUNDAY 26th. PM Gentle breezes between ENE and North, kept ranging along shore to the Northward at a distance of 4 or 5 Miles off, saw several Villages and some Cultivated lands. Towards evening several Canoes Came off to us and some of the Natives Venter'd on board, to two who appeared to be Chiefs I gave presents, after these were gone out of the ship the others became so troublesome….." (Beaglehole 1955:211)

On close examination, Cook's comments about human presence in the area such as… 'not ill inhabited'…(and)…'saw several Villages and some Cultivated lands'…all refer to the mainland, and he does not record any observations about the islands. It is on this voyage that Cook gives the islands their European name 'Poor Knights'. However his insertion of this name as an inter-linear addition in his journal suggests that this name was given sometime after he had written up the day's events (Beaglehole 1955:211).

Some historians have incorrectly interpreted journal accounts by Cook and other members of the ships company and scientists such as Banks, Parkinson, and Pickersgill as referring directly to Māori occupation on the Poor Knights Islands (Harper 1975:1449). This is due in part to confusion generated by the fact the ships log changes to the next day at noon rather than midnight, and also to the compression and miss-dating of events as members of the ships company wrote up their journals sometime after the events in question happened (Beaglehole 1955: in introduction of book). It is also due to factual error in some accounts. What is clear is that no mention of the island's vegetation or whether they were inhabited is explicitly stated in any accounts from this voyage (Parkinson 1784:108; Banks 1896:439).

The manuscript chart made by Cooks second Lieutenant Richard Pickersgill shows a remarkably accurate cartographic view of both Aorangi and Tawhiti Rahi and one that includes both European and Māori names (Figure 3.1). His reference to the 'The Knights' is an abbreviation of Cook naming them the 'Poor Knights' and is printed on the map, however the name 'Ohetiwoa' is hand written sometime after the chart was inked up. Assuming it was written by Pickersgill the name was probably obtained from discussions with local Māori. It is unclear what 'Ohetiwoa' is referring too since Pickersgill does not mention it in his journal (British National Archives 2012). It also does not appear to follow contemporary Māori language structure and may be a mishearing of O-he-tiw(h)athat may refer to a person or hapu (Robson 2006). Another explanation is that Tupaia the Tahitian on board the Endeavour, had obtained the name from discussions with locals either at Bream Bay the day before, or from waka (canoes) originating from the vicinity of the Whangaruru area that visited the Endeavour as they sailed north along the coast. Although this name does not turn up in any of the other Cook voyage journals there is a precedent in that Tupaia had the previous month identified 'Hitiroa' as the old name for RurutuIsland in the Societies group – the last place visited before the ships arrival in New Zealand (Beaglehole 1955:166).

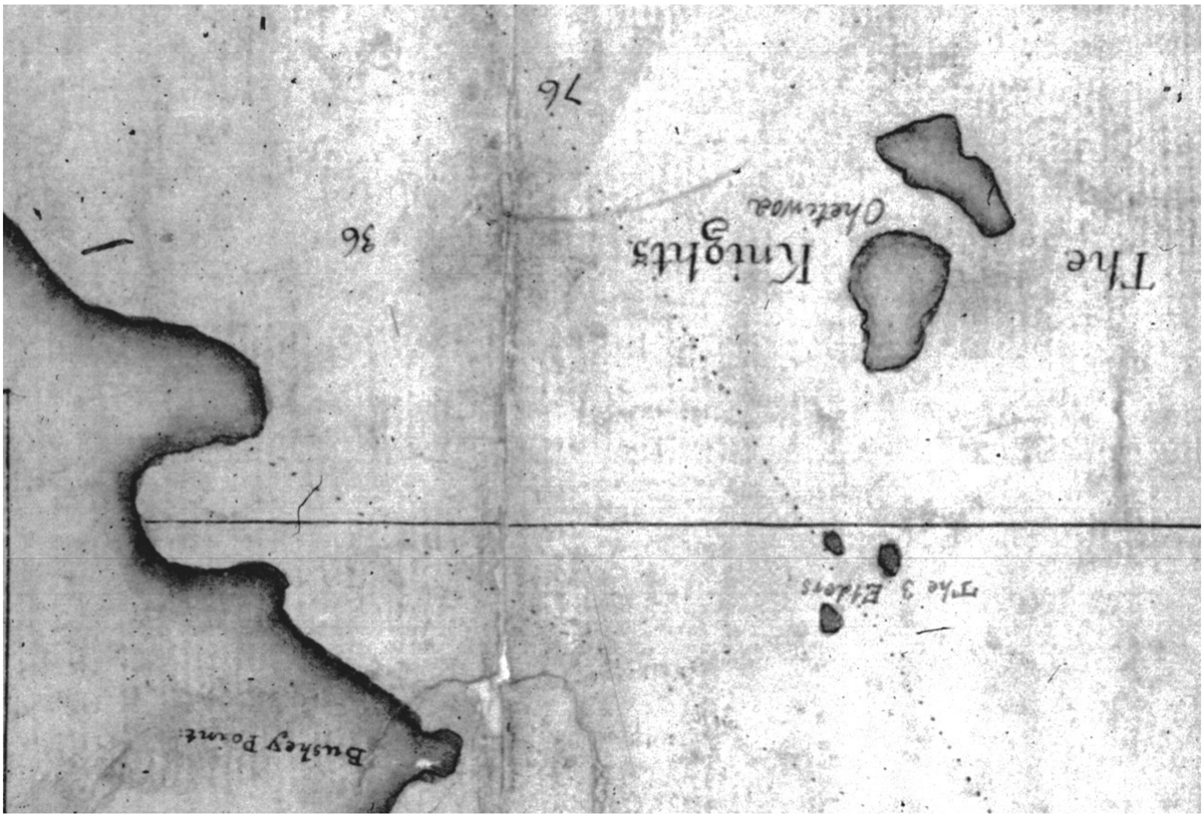

Figure 3.1 Sections of Lt Richard Pickersgill's chart titled 'Cavalli Islands to Mayor Island including the Hauraki Gulf'. This shows the Poor Knights Islands and the Māori name 'Ohetiwoa' [Note that Pickersgill drew the chart with north to the bottom. It is inverted here to place north at the top so as to match the other charts in this chapter]. (British Admiralty chart 552/3, shelf 3a)

It is speculated that Ohetiroa = Hitiroa = Tawhitiroa. Since Tawhiti Rahiri, Tawhitirangi and Tawhitinui are mentioned elsewhere in this chapter as variants on this island name, then (O)hetiwoa could be mishearing of (Ota)whitiroa in the Northland dialect (Coster pers. comm., 2015).If correct then Tawhiti Rahi Island could have been named after Hitiroa (modern Rurutu Island) in the Society Island group. This would give support to the Piripi argument that these islands were named after islands back in Polynesia (Piripi 1962a:46).

There are several theories about why Cook named the islands the Poor Knights that are relevant to this thesis. The most popular and enduring is he named them after a popular English pudding (Poor Knights Pudding). If the Tawhiti Rahi and Aorangi had a thick canopy of vegetation as they do today, then in November 1769 they would have been covered in the brilliant red flowers of the pohutukawa and in the higher places with the red flowering Poor Knights Lilly. This may have reminded Captain Cook of this medieval dish of bread dipped in egg, fried in butter, (Beaglehole 1955:211 footnote), especially if they were topped with jam as we eat certain similar dishes today. Professor Leach agrees that Cook may have named the islands after this dish, but argues that jam as a condiment is a modern addition (H Leach pers. comm., 2009). Contemporary recipes of the day instead mention a dish made from bread cut an inch thick, soaked in wine and sugar, dipped in egg, sack and nutmeg and fried a fine brown colour and served with butter sugar and cinnamon (MacIver 1784:161, 1787:169; Fraser 1791:149).

This dish might have been inspired by the island's appearance since the vertical cliffs and flat top of Tawhiti Rahi is reminiscent of a thick piece of bread. If true, the cinnamon brown colour of the dish could reflect a brown landscape de-vegetated by Māori horticultural burning practices. Indeed Beaglehole goes on to say in his footnotes that;

> "The islets under consideration are not much more than chunks of brown rock and clay, which would stand on a flat sea (and this day there was no more than a gentle breeze) as on a plate. Cook, revising his pages at this period (the name is an interlinear addition) was in a facetious and punning mood–cf. his joke in the next entry and his play on Piercy in the following one – and produced the name, perhaps even after a ship's meal. There was poultryonboardthe Endeavour." (Beaglehole 1955:211 footnote)

However examination of Hydrographic Department chart 522 drawn by Lt Pickersgill in 1769 (British Admiralty 2004) made on this first voyage of Cook's suggest another possibility, namely that Cook's use of the name had nothing to do with the island's description, but followed a theme started by Able Tasman. Since Tasman named the northern most islands of New Zealand the Three Kings, Cook may have been inspired to occasionally follow suit and apply contemporary religious/political titles that resulted in the naming of the Poor Knights along with the Three Elders, the Alderman's and Mayor Island.

Until a vegetation sequence for the island is reconstructed (see Chapter 4) it is unclear from the Endeavour accounts whether the islands were vegetated or de-vegetated at first European contact. If the vermillion hue of flowering pohutukawa and Poor Knights Lily influenced Cook's naming of the islands, then there is a real possibility that the island still had significant forest cover in 1769. The presence of an intact mature forest canopy and the lack of any comment about human occupation on the Poor Knights by Cook, his officers or the other scientists on board, may support the premise that the permanent large scale Māori occupation visible in the archaeological record – had not yet happened. However if Beaglehole is correct and the naming refers to a brown hue then it is likely that the islands had been cleared of bush at this time, and therefore Māori use had been initiated prior to 1769.

3.2.1.2 Accounts After the Endeavour

Even taking a liberal interpretation of the general comments about human presence along this coast made by various crew and passengers on the Endeavour, there are no definitive historic records that describe the extent and nature of human habitation on the Poor Knights until after the islands were abandoned in 1823. The only information we do have prior to 1823 is inferred from a series of naval charts and from some oblique comments in published accounts. The first of these was made on Marion Du Fresne's expedition, where the southern edge of Captain du Clesmeur's chart shows two unnamed islands 45km to the south of Cap Carre (Cape Brett) that presumably were plotted and drawn as the ship Marquis de Castries headed into Port Marion (Bay of Islands) in 1772 (Figure 3.2).

Figure 3.2 Section of du Clesmeurs chart 1772. The arrowed line is the route taken by the ship Marquis de Castries. The Poor Knights are the two unnamed islands at the bottom right side of the chart (Maling1996: plate 20).

The only non-European chart produced in this period was drawn by Ngapuhi rangatira Tuki Tahua (Collins 1798, Milligan 1964, Binney 2004). At Lieutenant–Governor Kings behest Tuki and Huru were kidnapped in 1793 from near Tahus's home on 'Motu-cowa' (Motukawanui in the Cavalli group of islands). Taken to Norfolk Island they became his guests. Before being returned to New Zealand Tuki Tahua drew a now famouschart for King that identified amongst other things the spirit road to 'Terry-inga' (Cape Reinga), the chiefs and numbers of fighting men in various localities around Northland and, of interest here, named islands down the east coast from'Manoui Taoai' (Manawa Tawhi also known as the Three Kings Islands) located off the top of New Zealand, down to 'O-ou-tere' (Aotea- also known as Great Barrier Island) located east of the Hauraki Gulf (Figure 3.3).

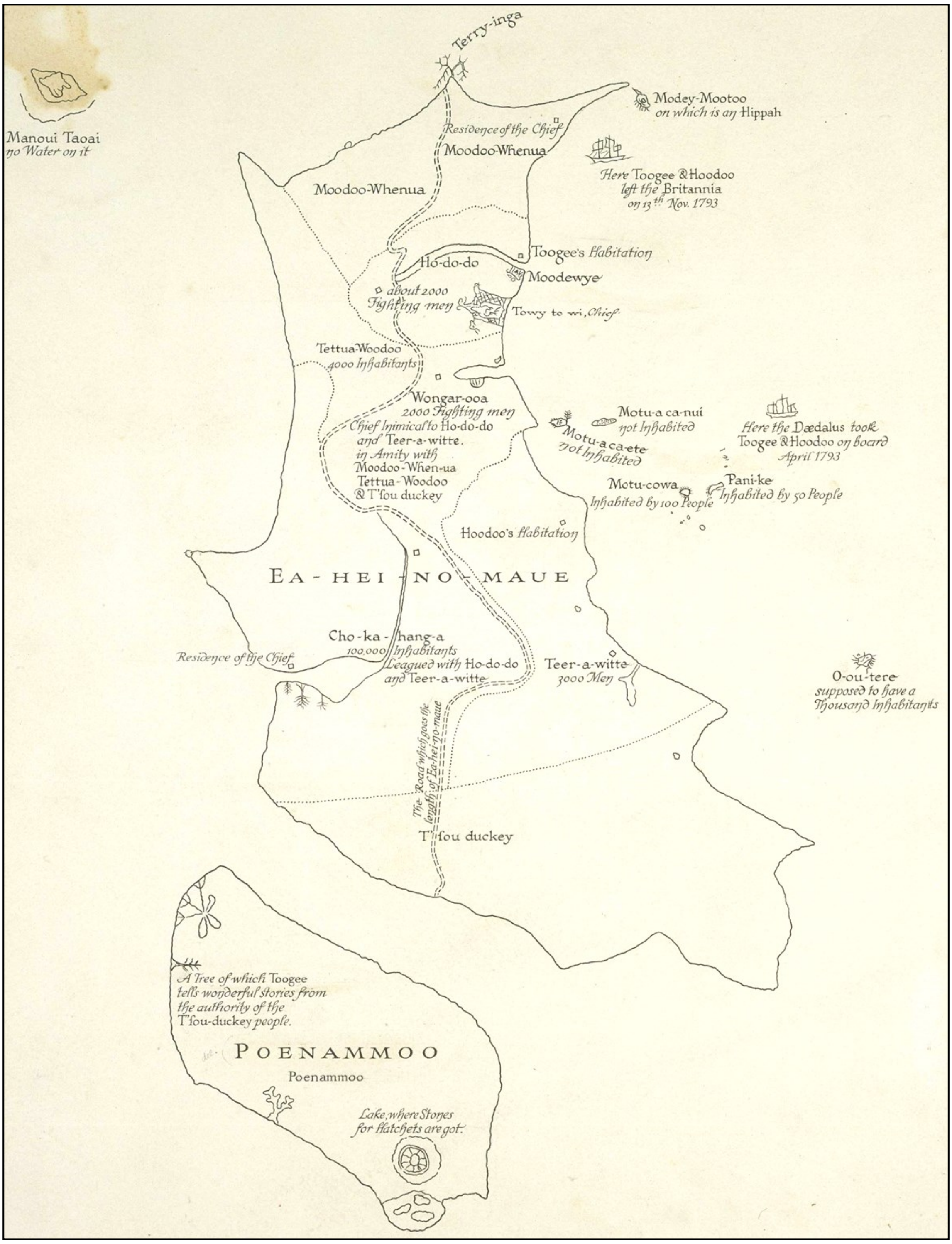

Figure 3.3 Map drawn by Tuki Tahua in 1793 while staying on Norfolk Island with Governor King. (Collins 1798)

Living on the CavalliIslands, it is understandable that other islands in close proximity are drawn in detail and their names accurately recorded, while distant places that he would only have heard off such as 'Poenammoo' [Pounamu] (South Island) are drawn small and with little detail. What is interesting is that between the Cavalli Islands and Great Barrier, none of the Hen and Chicken, Poor Knights, Little Barrier or Moko Hinau Islands are shown at all (see enlargement Figure 3.4). Since the complete map shows other places with itemized numbers of fighting men, this gap in his knowledge may reflect a lack of interest by Ngapuhi in land outside their traditional territory that is not a military threat (i.e. with lots of fighting men), or have valuable resources (such as Poenamu). It could also mean that these islands were not occupied at this time. Whatever the reason for this, it would appear that to Tuki Tahua, these groups of islands were of only peripheral interest.

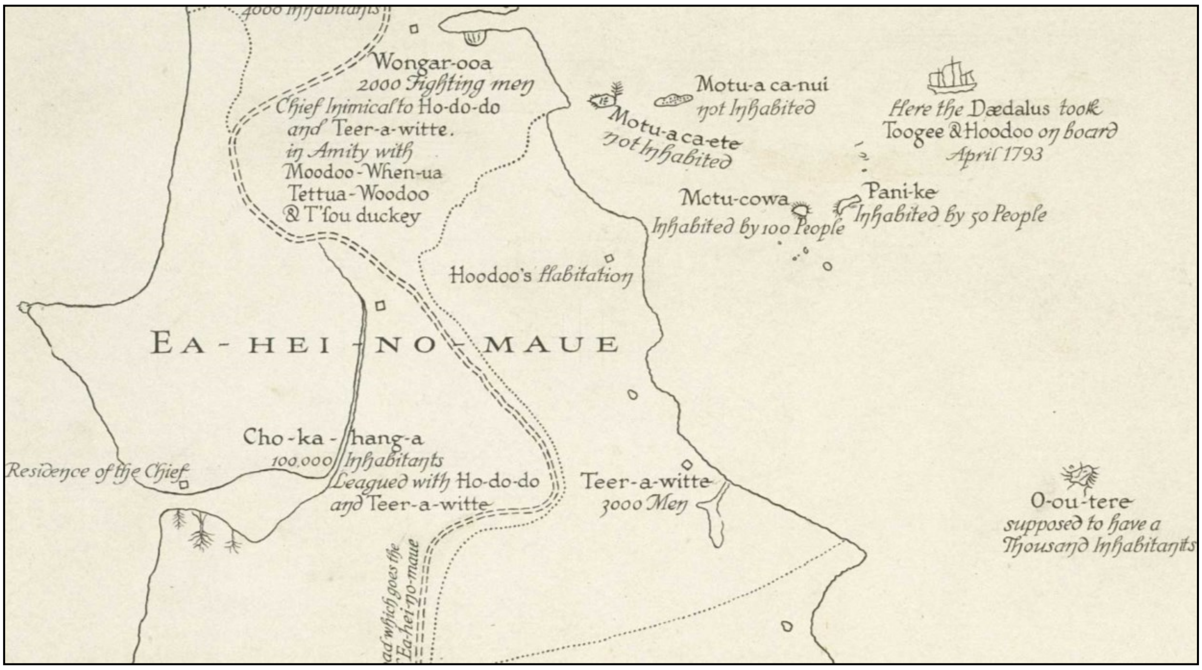

Figure 3.4 An enlargement of Figure 3 showing the east coast and islands from the Cavalli Islands to O-ou-tere (Aotea Great Barrier Island). The sea gap between Motu-kawa to the north and O-ou-tere to the south is where the Hen and Chicken, Poor Knights, Little Barrier and Moko Hinau Islands are situated (Collins 1798).

A more accurate chart, but with little historical information on it was drawn by William Wilson in 1801 when he was captain of the 'Royal Admiral' (Maling 1996: plate 26, Figure 3.5). The Royal Admiral was one of a small number of East India Company ships that came to visit the Northland Coast in the early years of the 19th century. Unlike most of these other ships the Royal Admiral was not passing through, but was specifically sent to the Thames area to collect spars. Probably to facilitate future spar collecting expeditions, Wilson drew a map of the Hauraki Gulf and part of the Northland Coast. Like the charts from Cook's voyage thirty five years earlier, this one shows the two unnamed but well drawn main islands of the Poor Knights group, and marks the track of the ship as it passed in shore of the islands. By chance, on board was a group of London Missionary Society missionaries heading to Tahiti. Rev Eldar mentioned in his journal on April 17th that;

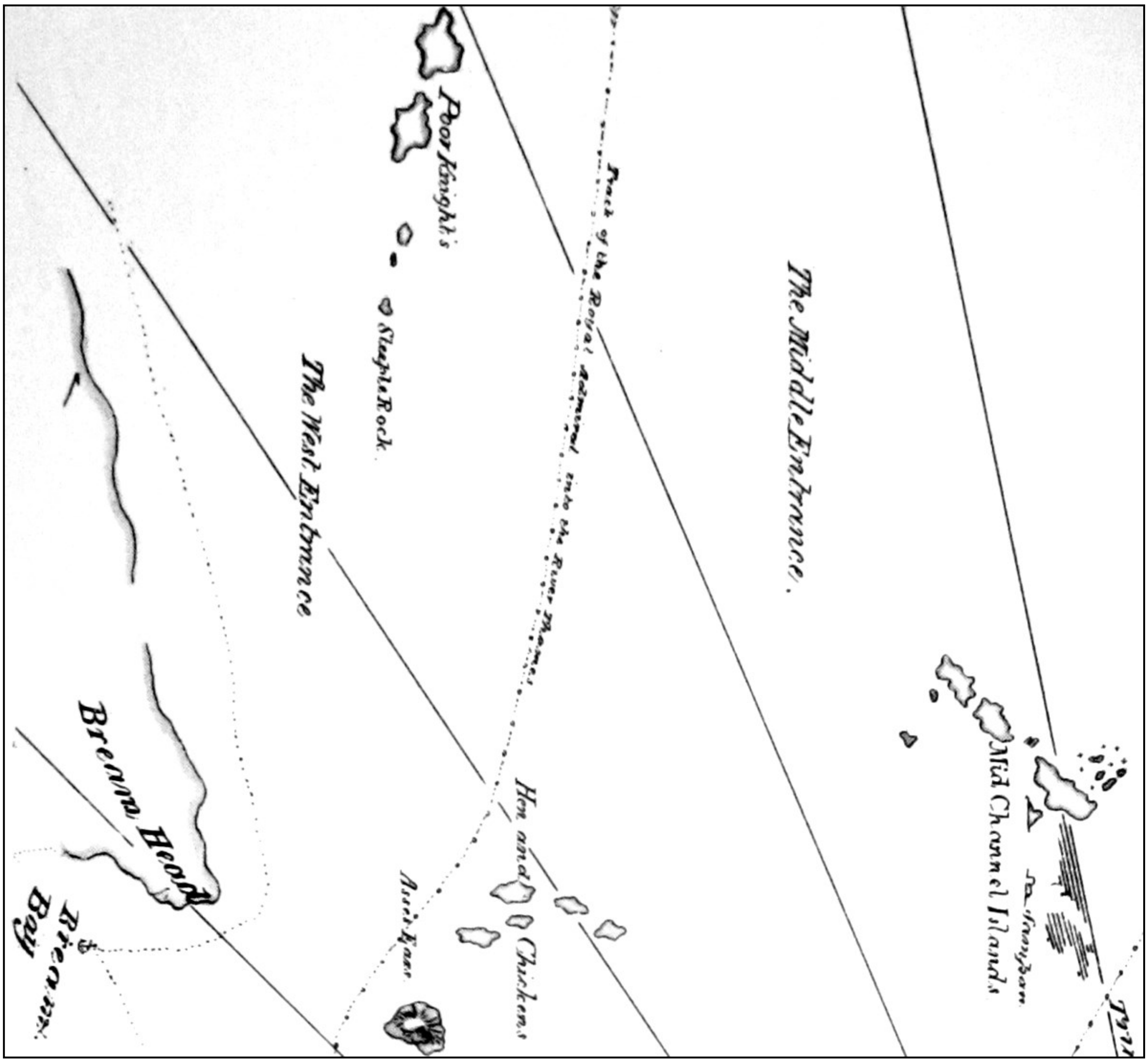

Figure 3.5 Section of Captain Wilsons chart showing the track of the 'Royal Admiral' as it passed Bream Head and Bay (west), Mid Channel Islands i.e. Mokohinau Islands (east), Hen and Chicken Islands (south) and the Poor Knights (north) [Note that the chart was drawn with east to the top. Therefore to match the other figures in the chapter it has been rotated so that north is now at the top] (Maling 1996: plate 26).

"At three in the afternoon the largest islands of the Poor Knights S.58 degrees E. The Poor Knights are small islands, situated in the Bay of Islands [sic] to which Captain Cook gave the name." (London Mission Society 1801:7)

Since Eldar mentioned seeing cooking fires on Great Barrier Island as they departed for Tahiti in July 1801 this quote above might suggest that he did not observe any such similar human activity on the Poor Knights.

Over a decade later, John Nicholas accompanied Reverend Samuel Marsden on his visit to New Zealand in 1814-1815. In his book about their travels, Nicholas notes on January 15th 1815 that;

> "…we found ourselves directly in front of a spot called by the navigators the Poor Knights, and consisting of an island, with three rocks of a grotesque shape, arranged in a parallel line, at a short distance from it". (Nicholas 1817:140)

Considering the human focus in the remainder of his account, this description may imply that Nicholas did not observe any people or signs of habitation on the island in 1815.

This perception is reinforced by the arrival of HMSS Store ships Coromandel and Dromedary in 1820, both of which sailed past the Poor Knights on their way to the Thames area. While James Downie on the Coromandel did make a very detailed and well drawn chart of the Thames area, it stopped short of the islands. William Fairfowl, the surgeon on the Dromedary, made a map of Northland's east coast which did include the islands, but at a scale that showed no detail (Maling 1996: plates 34). It may be significant that when Fairfowl and Midshipman Percival Baskerville on one ship and Ensign Alexander McCrae and Major Cruise on the other, all published accounts of their experiences, only Cruise mentions the island, and then only in passing (Cruise 1957:140).

Apart from Pickersgill's un-sourced appellation of the Māori name 'Ohetiwoa' to the islands in 1769, all the subsequent accounts up to 1823 provide no information on the nature and extent of Māori occupation in this early historic period. The first significant account of Māori habitation is from Bay of Island missionary records and is associated with its demise following inter-tribal conflict during the so called 'musket wars'. Inter-tribal conflict is visible in the New Zealand archaeological record from 1500AD onwards, with the sudden and widespread adoption of 'pa' or defended hill forts (Irwin 1985). The identification of over 5000 of these distinctive site types makes pa the distinguishing archaeological feature in the second half of New Zealand's prehistoric sequence. By the middle of the 18th century, conflict appears to have increased, as various groups attempted to expand their authority especially in the areas of the North Island with horticultural potential (Ballara 1998). The period from 1818 through to approximately 1830 saw an escalation of conflict due to the introduction of muskets and the temporary military dominance of certain tribal groups such as Ngapuhi who obtained guns first. This musket war period saw numerous long distance raids into the Thames and Waikato areas involving thousands of men (Smith 1910). However a large number of badly documented smaller battles are known to have occurred locally in Northland as certain hapu (sub-tribes) with guns gained 'utu' or revenge for earlier grievances, and this is what appears to have occurred on the Poor Knights. In 1823 an account of the attack on the islands was recorded by Bay of Island Missionaries when the Reverend Samuel Leigh met in January 1824 with Mr. King in the Bay of Islands. Mr John King told Leigh that the Te Hikutu people based at the adjacent settlement of Rangihoua had attacked the Tawiti-rahi, or Poor Knights Islands;

> "Our natives," said he, "got possession of the sails of the ship 'Brampton,' in which Messrs. Marsden and Leigh were wrecked. They cut up the canvas, and fitted their own canoes with sails. After taking a sufficient force, with arms and ammunition, on board, they steered for the above islands. When they landed, the natives, knowing that the invaders had muskets were panic-struck and fled in all directions. Numbers threw themselves from steep precipices into the sea, and were drowned. Our people pursued the fugitives, and continued the work of destruction until they had depopulated the islands".
>
> (Strachan 1870: 174-176)

A review of King's unpublished journal suggests that the attack took place between the 10th and 16th of December 1823. On the 16th King wrote;

> "The fighting party came back – brought a number of slaves and canoes from the Poor Knights – this party joined another party from the other side of the Bay and they made a great slaughter with the people of the Poor Knights…"
>
> (Scott 1972: referencing Kings unpublished journal)

3.2.2 19th Century Records After Occupation Ended

By the end of the 18th century then, Ngatiwai as neighbours to the southern alliance of Ngapuhi were taking an active part in Pomare's military forays to the south. At the same time the Te Hikutu hapu of the northern alliance, some of whom were based on the Pouerua Peninsula (forming the northern arm of the Bay of Islands) around Rangihoua and Te Puna, appears to have made a specialty of attacking Ngatiwai settlements along the Northland east coast and on the islands, with locally recorded accounts of attacks at Mahurangi Harbour, Great Barrier Is, Mimiwhangata Peninsula and the Poor Knights Islands (ARC Mahurangi Interpretation 2006, Murdoch 2010, Slocombe 1994, Fraser 1925). Early European visitors such as D'Urville comment on taua (war parties) heading south and note abandoned settlements in the Whangārei Heads area in 1826 (Wright:1950:150), while later commentators report indirectly of abandoned settlements at places like the Hen and Chicken Islands (Reishek 1881). Cranwell and Moore cite George Graham for Hen Island being abandoned in 1821 (Cranwell and Moore 1935, 301). If

Graham is correct then these islands most likely were also attacked since at least 15 Ngapuhi taua travelled south through the Hauraki Gulf between 1810 and 1832. Although Ngatiwai was often party to these expeditions they were also on occasion targets. The relationship between Ngatiwai and Ngapuhi was at best, uneasy (Judge Sinclair: 1998). The Musket Wars were an escalation of an ongoing period of conflict that started long before European arrival in New Zealand; however it is in this period at the end of prehistory, and in this context of endemic and escalating conflict, that permanent Ngatiwai settlement on the Poor Knights may have been established.

Considering how little was recorded while the Poor Knights Islands were inhabited, it is surprising to find that significant ethnographic information was recorded after they were abandoned. The first to provide information was Dumont D'Urville. As part of the Duperry expedition, he may have sighted the Poor Knights to the north in 1824. However it was during his second visit in 1827 that he became the second person after Missionary Leigh to record the island's Māori name when he referred to them as 'Tawiti Rahi' (Maling 1996:122., Wright 1950:167). This name appears to have been obtained from indigenous sources (see Piripi both earlier and later in chapter) since it is corroborated by early 20th century visitors to the Poor Knights who noted that local Māori commonly referred to the island group as 'Tawhiti Rahi' (Cockayne 1905:251). D'Urville was sailing up the Northland coast in early 1827 and on two occasions sighted the islands. The nearest he got was 6 miles to the south-east on the evening of March 3rd 1827;

> "Seen from the this side they appear to consist of one island about a mile in diameter, quite round, rocky and steep at its edge, and three or four detached rocks nearer to land, which were very steep and absolutely bare" (Wright 1950:167)

From this description D'Urville was clearly describing Aorangi Island and some of the small rocky islets or stacks that are found around it. He did not see the larger but lower island of Tawhiti Rahi because Aorangi Island blocked this view. He makes no mention of human occupation or vegetation cover apart from the reference to the uninhabitable detached rocks (stacks or pinnacles) being 'bare'.

Richard Hodgskin who passed by the islands on January 1833 on board the store ship HMS Buffalo made the only account that definitely identified human presence on the islands after the 1823 battle.

> "Owing to strong unfavorable winds, we hove to on the 10th under the lee of three barren-looking islands, called the Poor Knights, but found them inhabited. Observed fires on the southernmost one during the night. Observed, on the 10th, a canoe put off from a

small cove, which paddled alongside; a native sprung on board, and the canoe shoved off, leaving him with us; we christened him "Tommy Poor Knight;" he turned out to be a pleasant fellow, and caused a great deal of fun in the ship; he said he thought the ship was going to England, and he wanted to go there too; but he was sadly disappointed when informed we were bound to Maurangee" (Hodgskin 1841:30).

Interesting parts of this account include the 'barren' nature of the islands which although made 74 years after Cook, may give some support to Beaglehole's premise that the Poor Knights were de-vegetated at the time of European contact. Another significant point is that despite chief Te Tatua placing a tapu on Tawhiti Rahi the islands after the massacre, Hodgskin notes that people were present, at least on Aorangi, the southern most of the three islands. Considering that Tuaho had mana over the southern Aorangi Island, this occupation ten years after the massacre may reflect the fact that Te Tatua's tapu only applied to the northern island of Tawhiti Rahi. Another possibility is that the people noted by Hodgskin were not living there, but rather were visiting fishing parties of the sort that Hana Paengatai had mentioned who still occasionally utilised the island's coastal fringe after the massacre and up to the time of her testimony in 1928 (NLC 1928) Corroboration of this can be inferred from a letter that mentioned, some years before 1922, that a party(presumably local Māori) applied unsuccessfully to the Marine Department for permission to establish a fishing settlement on the Poor Knights (Bollons 1922).

Joel Pollack was an early trader and land speculator in Northland who claimed to have purchased the Poor Knights, Moko Hinau, Taranga (Hen) and Maro Tiri (Chicken) and Rimariki Islands in 1844. Amongst the New Zealand National Archive files associated with Pollack'sclaim to own these offshore islands, there is a small untitled, rough sketch showing Māori names along the east coast of Northland and the offshore islands (Figure 3.6). It is unclear who drew this sketch and when it was made. A note on the back claims that the pencil notes on the front are "Governor Fitzroy's approbiation (sic) of the Poor Knights and Pokohinau Islands (sic)" which suggests that it has been used to substantiate Polacks ownership. The Old Land claim Files (see later section) note that Polack supported his claim with a chart made by Duperry in 1827. It is possible that this sketch is the chart referred to in Polack's testimony but if so his description of it contains some errors. For example, if it was made by Duperry then it must date to 1824 and have been made from a significant distance away since he never sailed further south than Cape Brett, the southern arm of the Bay of Islands. If however it was made in 1827, then it most likely would have been made by D'Urville, who had been on Duperry's 1824 expedition and who again passed along the coast in command of his own expedition in that year. Support for D'Urvlle's authorship of the

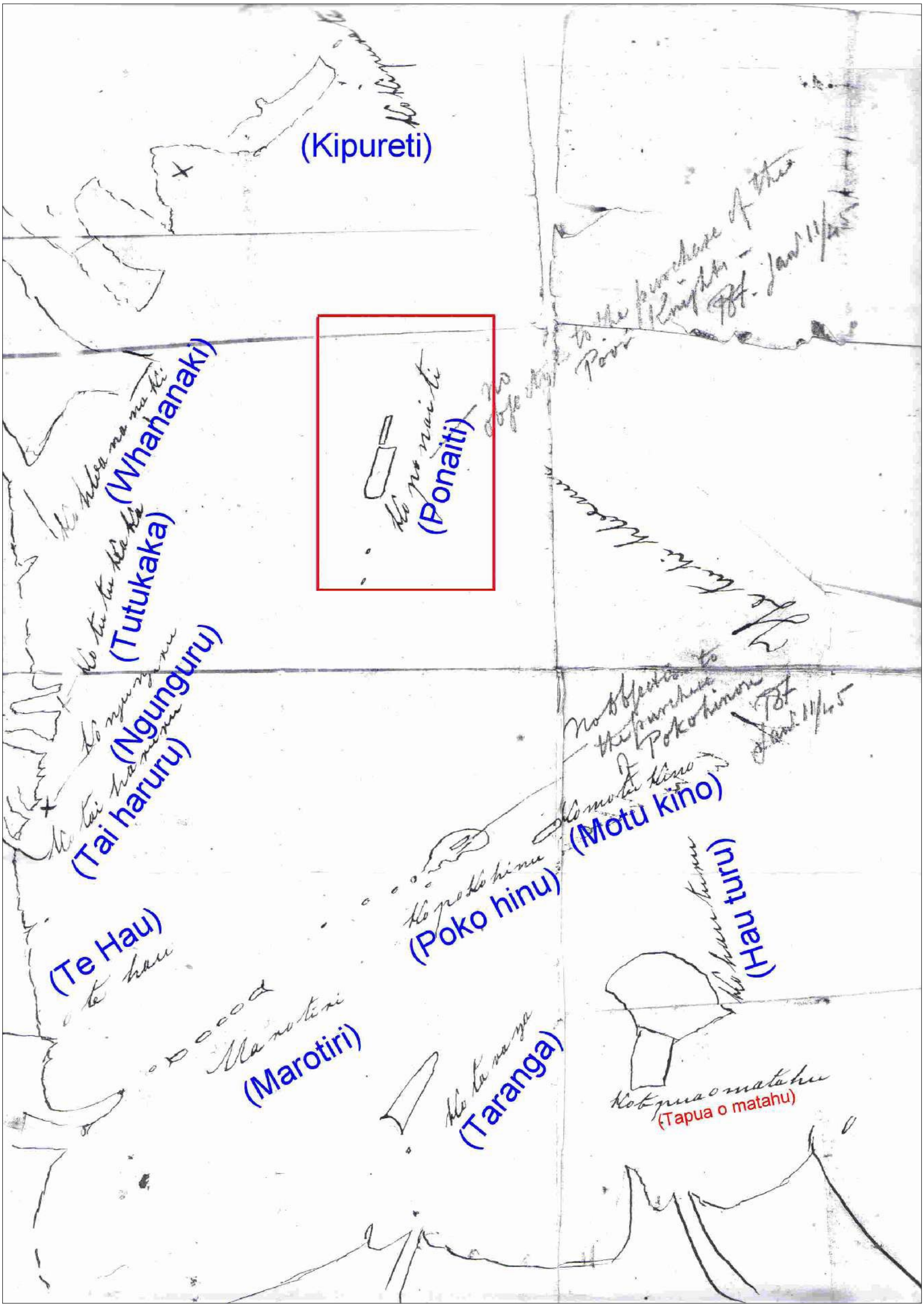

Figure 3.6 Joel Polach sketch of islands within the territory of Ngatiwai. This transcribed enlargement identifies the Poor Knights Islands as 'Ko po nai ti' [bordered with red at the centre of the sketch]. (National Archives (NZ) file OLC 1209)

sketch comes indirectly from his own account notingthat when anchored in the Whangārei harbour he had recorded from the visiting Ngapuhi rangatira Rangituke;

> "..the names, in the language of the country, of the adjacent lands and islands, which I have, as usual, substituted for those of Cook". (Smith 1909:416)

It is also possible that this very rough sketch was made by Polack himself from information provided by the Ngatiwai Rangatira who sold him the land. This would explain the detailed and accurately located Māori names along the Tutukaka coast, out to Aotea (Great Barrier Is), and down to Hauturu (Little Barrier Is), because these places all lie within the traditional territory of Ngatiwai. If true, it might also explain the use of 'Ko Kipure ti', the transliterated European name 'Cape Brett' for the southern arm of the Bay of Islands. Since this area lies within the adjacent territory of Ngapuhi, the local Māori name 'Rakau Mangmanga' may not have been in common usage among Ngatiwai. However this argument does not explain why the Poor Knights Islands located centrally within Ngatiwai territory, did not use the Māori name 'Tawhiti Rahi' and instead use 'Ko po naiti', which is a clear transliteration of the English word Poor Knights. 'Po naiti' as the accepted name of the Poor Knights Islands also turns up in New Zealand Native Land Court Papatupu minute books that investigated Māori title on Great Barrier Island (Murdoch 2010). While the lack of use of the Māori name 'Tawhiti Rahi' may reflect lack of interest by Ngapuhi in land outside their traditional territory, it does not explain why its Māori name was not in common usage among Ngati Rehua on Aotea (Great Barrier Island)who are closely affiliated with Ngatiwai. This use of a European name therefore hints that at least in the latter part of the 18th century, the Poor Knights Islands were peripheral and of little importance to both Northland and Great Barrier based Ngatiwai communities.

At around the same time as Polack was attempting to purchase the Poor Knights Islands, a chart was compiled for William Fitzroy showing the coast line from the Bay of Islands to the River Thames (Figure 3.7). Probably made when he was Governor of New Zealand (1845-6) the date of drawing is obscured and it does not state which original charts it was made from. However the dates of the magnetic variance of 1769 and 1834 suggest strongly that the charts came from Cooks first voyage to New Zealand in 1769 and from HMS Alligators visit in 1834. What is interesting is that apart from showing the Poor Knights Islands, it shows the main named areas on the coast adjacent to the Poor Knights that are discussed elsewhere in this thesis. From the south northwards, these include Te Wara Pt (Whangārei Harbour), Warinahi (Whananaki), Tutukaka Harbour, Ngunguru, Boat Passage (Mimiwhangata Pt and small islands including Rimariki Island – later known as Wide Berth Islands), Whangaruru and Whangamumu Harboursand Rakau Mangamanga (Cape Brett).

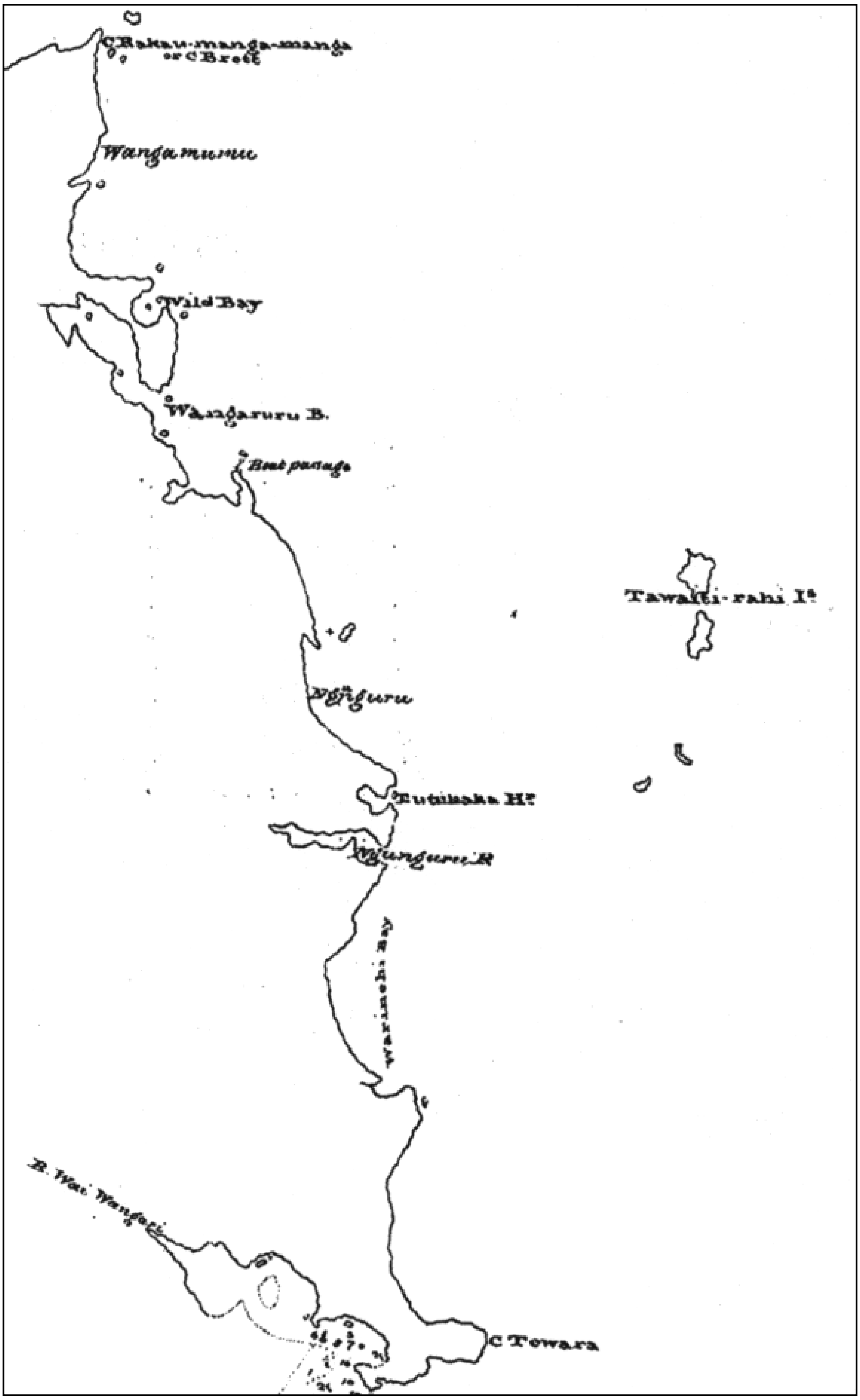

Figure 3.7 Section of the Fitzroy compilation map from Cape Brett to the River Thames. Probably based on charts from Cooks first voyage (1769), and from charts made by Lt Woore on the voyage of the Alligator (1834). The date is obscured but it was probably pulled together in 1845-6 when Fitzroy was governor of New Zealand. It shows locality names along this coast that appear in this thesis (British Admiralty chart L5457, shelf XU).

The most important ethnographic account of the Poor Knights was made by William Fraser one hundred years after occupation ended. As the Whangārei Harbour Board engineer Fraser made a number of visits to the islands between 1914 and 1924. His view that Aorangi was the main center of occupation and that Tawhiti Rahi was of minor importance was set out in a press statement from the Internal Affairs Department following his partially successful pig eradication expedition in 1924. Here he states that;

> "The larger island [Tawhiti Rahi] is covered principally with scrubby bush with heavier mixed forest in the basins. On this island there does not seem to have been any settlement, and the native flora and fauna is in a very healthy state………The smaller island of the two [Aorangi], now covered with fairly heavy bush, bears unmistakable evidence of having once been thickly populated." (Fraser 1924: 8)

In 1925 he wrote the only formal published account of the Poor Knight'sMāori history. This was based on the recollections of his mainland Ngatiwai informants, since by that time the islands had been abandoned for 100 years. Ngatiwai informed him that 300 to 400 people had lived on the islands for many generations, gardening and harvesting the local mutton-bird called the 'rako'. Fraser spent most of his time on Aorangi and interpreted the extensive earth and stone work structures as being the remains of Māori habitation and cultivation. He also remarked on the untouched archaeological landscape where carved wooden items, obsidian flakes, wooden bowls and clubs, hair and hair cutting tools, skeletal material and cloaks were found scattered on the ground or concentrated in caves. By the time of this publication in 1925 he had modified his views expressed in his 1924 report. From believing Tawhiti Rahi not to have been settled he now stated that it was in fact settled by a hapu called Ngatiwai under Rangatira Tuaho. However he still believed Aorangi was the major settlement as was shown in his comment that Te Tatua was rangatira of the Ngatitoki hapu on Aorangi who was "ruler over both islands" (Fraser 1925: 8). It is only on hearing Hana Paengatai's testimony in 1928 and being questioned by the court that he accepted that Te Tatua was chief of the Ngatiwai hapu and lived on Tawhiti Rahi (Native Land Court 1928:251).

Over time mainland mutton-bird colonies declined and became extinct due to predation by rats. Since the Poor Knights lacked rats the endemic Buller Shearwater (Rako) mutton-bird resource there will have increased in value. Therefore the export of such mutton-birds to mainland coastal settlements could have offset the need to import estuarine and harbour shellfish, obsidian and totara wood that was not available on the islands. Fraser commented in a letter to W.R.B.Oliver in 1955 that;

"Rako is the Māori name of *Puffinus bulleri*, and my old Ngatiwai informants of 40 to 50 years ago on this coast would tell me that their relations of the old time on the Poor Knights made a trade with the mainlanders in preserved young rako, as this species of mutton-bird was in greater demand than the more common kind, and that the Māori protected the nesting places and the parent bird" (Harper 1983:301)

Captain John Bollons worked for the Marine Department and in 1898 became Captain of the Government Services Steamer 'Hinemoa'. His various duties included supplying and supporting lighthouses, servicing and visiting castaway depots and charting coastal waters. He had a keen interest in natural history, was fluent in Te Reo (Māori language) and had a long term fascination with Māori culture that probably began with his fostering with 'Old' Barney Buller (Tohi te Marama) when at 16 he was shipwrecked at Bluff in 1881 (McLean 2013)

By the early 1920s his profession had led him to visit many of the offshore islands along Northland's east coast. He was responsible for taking Cockayne to the Poor Knights in 1905 on what was the first documented visit by a European, and he made landings on both Aorangi and Tawhiti Rahi. In 1922 he wrote a letter, possibly after a request by the Secretary of the Marine Department, providing information on the Poor Knights Islands. In a few words Bollons provides a concise account of fauna, flora, archaeology and the depredations of the introduced European pig on the biota of Aorangi Island.:

"There is very little known about the flora, fauna or native particulars of these Islands. That they were inhabited by the natives is certain. The built up stone terraces are Māori work. I brought away from their many years ago a lot of carved woodwork, being portions of a carved house. These have been deposited in the Auckland Museum. I also found two stone adzes, and many pieces of obsidian. Both the North and the south Islets carry evidence of native occupation".

On the North Islet the tuatara lizard is found, but I have not seen the pig. On the south Islet the pig is to be seen, but not the tuatara.

On the North Islet the large land snail, Placostylus hongii is abundant.

The bell bird – Koromiko – is found in great numbers on both Islets.

The bush is dense on the north and fairly thick on the south Islet and consists principally of pohutukawa, taraire, tawa, taupata, koromiko and ngaio.

These are most interesting Islets and would repay a month's residence by interested men. By this I mean botanists, zoologists and others. Some years ago a party applied for the right to use the Islets as a fishing settlement.

The Department, knowing the place was unsuitable for such and desirous of protecting the faunaandflorawouldnotsanctiontheproposal". (Bollons 1922)

There are few confirmed Māori place names on the Poor Knights Islands. After a number of scientific research visits in the 1960s it was suggested that names be given to places throughout the island group to be used by visitors as reference points. In 1966 the New Zealand Geographic board approved a list jointly submitted by A.H.(Pick) Pickmere and by G Stephenson. Although most of these are shown on Pickmere's undated rough draft plan of the islands (Figure 3.8) examination of SO Plan 29179 shows that most were allocated in 1926 when he first surveyed the Poor Knights Islands.

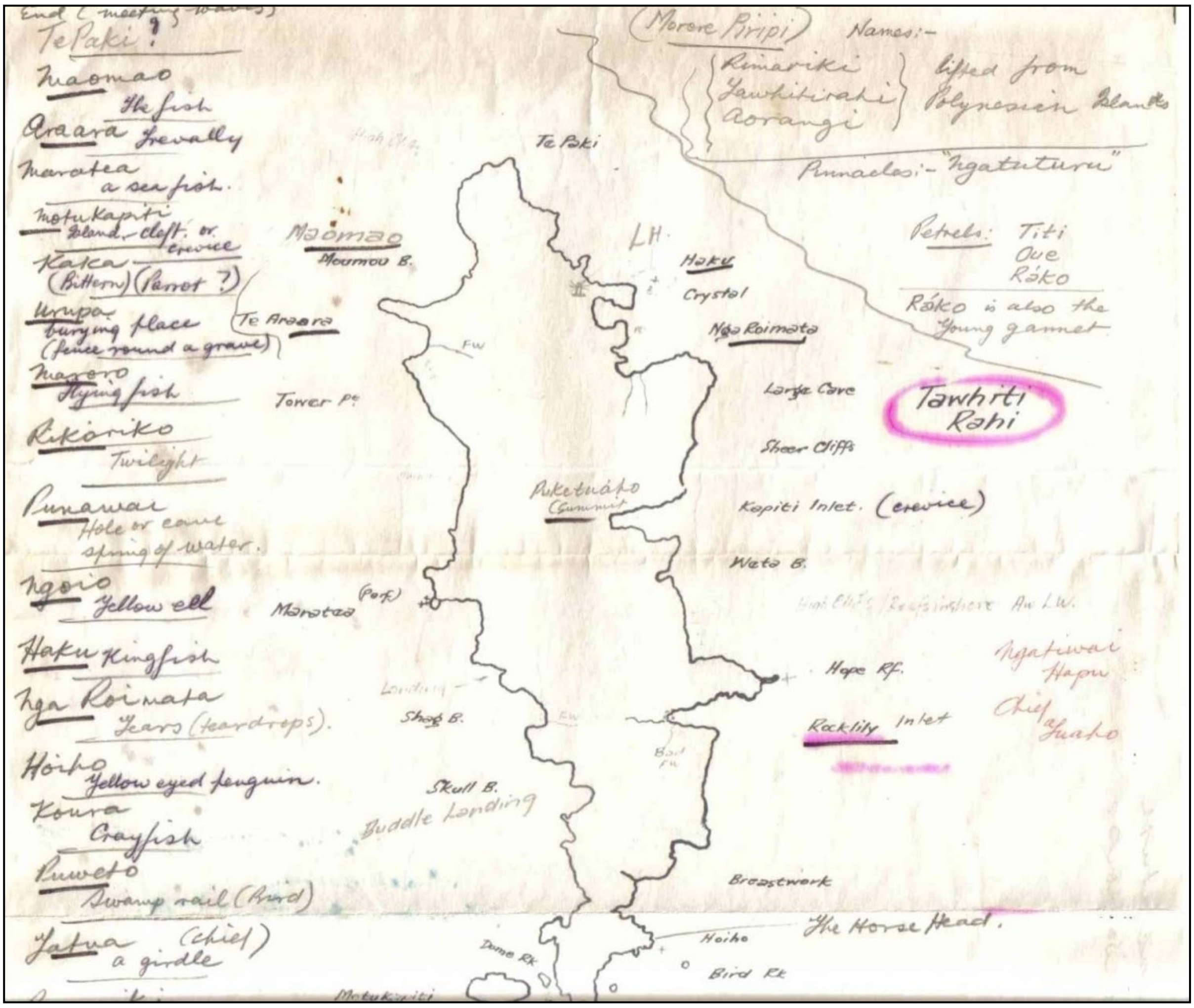

Figure 3.8 Draft plan from Pickmere Family Archives. Shows the choice of both Māori and European names that can be found on SO Plan 29179 (Pickmere Family Archives: Poor Knights Islands 2006).

With the exception of 'Puketuaho' whose location has been moved northwards to the center of the plateau, these names are still currently in use on NZMS 260 metric map sheet R06. This list of names included European ones apparently sourced from ongoing local usage by various visitors to the island, and local fisherman. Examination of archival documents held by the Pickmere family included two letters noting that Ngatiwai paramount rangatiraMorore Piripi considered only the names of islands Tawhiti Rahi, Aorangi and Aorangaia to be ancient ones with origins that extend back to Polynesia, and that all the other Māori names are recent constructs and have no antiquity. So where do these 'pseudo' names come from? Some of the Māori names arbitrarily allocated by Pickmere to Tawhiti Rahi are clearly inspired by famous places found elsewhere in Northland such as Te Paki Point in the Far north and Nga Roimata Point on the adjacent Northland coast. Others appear strongly influenced by Fraser's ethnographically sourced information of Māori settlement published in 1925. For example the association of certain chiefs with particular islands is reflected in the central high point of Tawhiti Rahi being named after Tuaho and the peak on Aorangi named after Te Tatua. Considering the traditional evidence given in the 1928 land court sitting reversed these associations (as was agreed with at the time by Fraser when questioned by the Crown prosecutor), then there is a case to argue that at least these two names should be transposed (NLC 1928:251). However the key point is that aside from the actual island names, all of the Māori names of places on the islands were not taken from common usage by Māori, but instead are 20th century constructs created by Pickmere (Appendix 2).

The historic records discussed above are remarkable in that there is only one eye-witness report by Europeans about Māori presence on the Poor Knights, from Hodgkin on the Buffalo, and this only occurred in 1833, 10 years after the massacre of 1823. The record of settlement ending is well documented both by ethnography, missionary journals and Native Land Court hearings. This implies that the archaeological evidence of large scale Māori occupation reflects settlement that ended in 1823 and which started in the prehistoric period. However exactly when it started is still unclear. The ancient names 'Tawhiti Rahi' and 'Aorangi' that were sourced from Polynesia imply that the islands were part of the tribal area of Ngatiwai since the time of first settlement of New Zealand. Similarly the Māori Land Court Records suggest that the use of the islands between Aotea (Great Barrier) and the Northland mainland also had a long history. However the lack of any substantiated embedded knowledge in the form of named places on the island hints that permanent occupation on the Poor Knights Islands by Ngatiwai may have been short term and only extending for one or two generations. These apparent contradictions in traditional accounts about the timing of settlement will be addressed in Chapters 4 and 5.

3.2.3 History of Land Ownership

Much of the following legal history has been summarised from unpublished archival research carried out by Linda Walters in 1987 on the ownership of the adjacent Moko Hinau Islands (Appendix 3). All references in section 3.2.3 are found at the end of Appendix 3 – not in the bibliography of this thesis.

In 1844 the trader and land dealer Joel Polack claimed to have purchased the Poor Knights Islands from Ngatiwai chiefs located in the Whangaruru area. On the 15th July and the 1st of August 1844 he placed the following advertisement in the "Māori Messenger":

> "Kia rongo nga tangata kotoa ki tenei pukapuka - kua hokona enei motu a Tawitirahi, a Marotiri, a Pokohinu e poreka i a Ngatiwai: ko Maini ratou ko Pokai ma nga kai tuku na, kaua te tahi tangata e poka noa i te tuku; enei motu kua hokona ketia e Poraki."
>
> "Harken all men to this notice. The Islands of Tawitirahi, Marotiri and Pokohinu have been bought by Polack from the Ngatiwai; Maihi (Marsh Brown Kawiti) Pokai and others are the sellers. Let no one interfere by attempting to sell these islands which have been bought by Polack." (Māori Gazette. 1844: No.7 vol.4; in Walters 1987:4)

Polack obtained the signatures of eight Ngatiwai "chiefs" identified as Maihi, Pokai, Rerihou, Aupeki, Keke, Tini, Ihu and one unreadable other on a Deed of Sale for the Poor Knights Islands. None of these names appear to relate to Te Tatua or to his son Hōri Wehiwehi or Tuaho who twenty-two years previously had lived on Tawhiti Rahi and Aorangi Islands.

On the 4th November 1845 Polack enquired of Governor Sir George Grey as to when Crown Titles would be issued for his purchases. Then on the 1st May 1846 he applied to Grey for Crown Grants for the three island groups of the Poor Knights, Hen and Chickens and the Moko Hinaus. He also enclosed a survey of the islands done reputedly by Captain Duperry in 1827(see the previous section for comment on this), claiming he himself had been unable to carry out a survey due to a lack of anchorage at the islands. Polack also stated on 7 August 1845, that the original Deed of Sale had been lost due to an explosion at his home in Kororareka in March 1845; however, a copy had been made and attested to by the original witnesses of the sale. Grey referred the matter to the Members of the Executive Council for a decision. Various correspondences followed between Pollack, Grey, the Executive Council and the Secretary of State, resulting in Grey disallowing Polack's claims to all three Island groups (Correspondence to the Colonial Secretary from Polack: Old Land Claims file 1210; in Walters 1987:5, Government Gazette: 12 June 1845).

In October of 1849, two Māori lodged objections to Polacks claims. The first was Tawatawa, whose name appears on the original Deed of Purchase as one of four people who received additional payment. The reason for this additional payment being made is not known, nor is it known why one of the payees later lodged objection against a sale in which they themselves participated. Tawatawa stated that only one person named on the Deed had a right to the islands, and that was Pihi.

Although Polack's claim was never substantiated, and descendants of Te Tatua defended their claim to the islands in the courts up to the 1920s, the land was placed into private ownership. Undocumented on-going issues of ownership are hinted at by the 1860 chart of Polack's land claim, which showed the Moko Hinau, Marotiri (Chicken Islands now including 'Hen' or Taranga) and the Poor Knights Islands and their position adjacent to the Tutukaka coast (Figures 3.9 & 3.10).

In 1882 all these islands were acquired by the Crown at auction. All were subsequentlyreserved for lighthouse purposes under the Reserves Act 1881 but it was not until the 1960s that an un-manned light beacon was erected on the Poor Knights. Mostly at the instigation of Fraser, the reserve designation for the Poor Knights was progressively upgraded, first to scenic reserve, and

Figure 3.9 General plan showing the relative positions of the islands claimed by J S Polack is dated to 1860. Draft plan from Pickmere Family Archives. Hand written additions identify Old Land claim reference numbers 201-208 and mention file number 1200 (Landonline, Land Information New Zealand archives 2008).

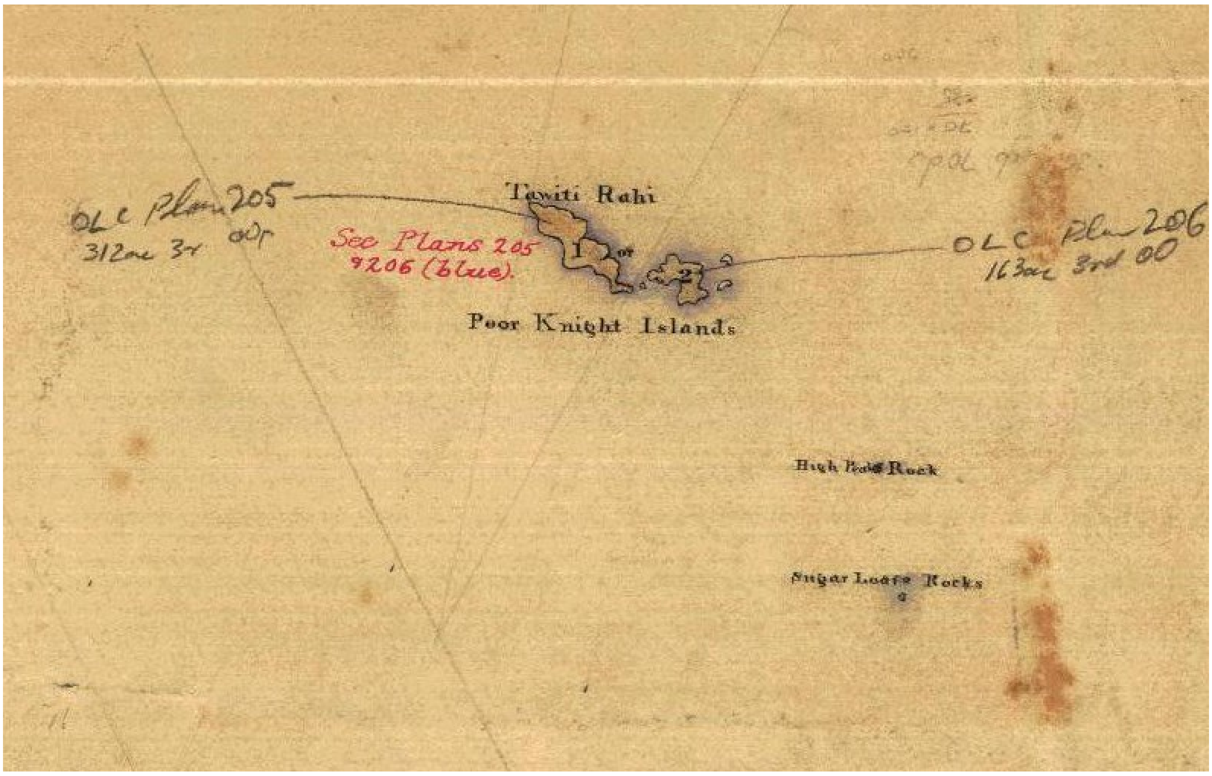

Figure 3.10 Enlargement of plan 3.9. This shows the 312 acre size of the named Tawhiti Rahi Island in the Poor Knights Islands group and hand written additions referring to Old Land Claim numbers 205 (Tawhiti Rahi) and 206 (Aorangi) and file number 9206 'blue' (Landonline, Land Information New Zealand archives 2008).

finally to a nature reserve, so as to ensure the rare fauna and flora was protected. Recognition of the rare marine values led to the waters around the Poor Knights being gazetted as a (limited) marine reserve in 1981. A fully protected marine reserve with no fishing allowed was finally achieved in 2000.

3.2.4 Historic Record Summary

Who occupied the islands?

Ngatiwai currently utilise the islands and coastlines between the Tai Tokerau (Northland) coast and Aotea (Great Barrier Island) and this usage extends back through their Ngati Manaia ancestors to the first traditional history records. The history of land ownership clearly identifies Ngatiwai as the people with manawhenua (authority) over the Poor Knights. The two main islands in the group were occupied by two different hapu of Ngatiwai. While the Ngati Toki hapu under chief Tuaho occupied Aorangi and had strong links to the Matapouri area, Tawhiti Rahi was inhabited by a Whananaki hapu led by chief Te Tatua that had links to an area that includes (but is not limited to) Rockells, Moureeses, Tauwhara and Otamura Bays (Figures 3.11 and 3.12). Hōri Wehiwehi – the son of Te Tatua – had interests in the Mimiwhangata-Whananaki areas.

Land blocks with his name as a seller include Paparahi (ML 2184), Te Rua Tahi (ML 314), Opuawhanga Block 1 (Roll 8), and Whananaki, and in the overlapping Te Rua Tahi block (ML 314) that including Roimata Pt (then known as Kohinutupou) where his father Te Tatua buried people killed on Tawhiti Rahi in 1823.

The purported sellers of the Poor Knights to Polack in 1844 did not include Te Tatua or his son Hōri Wehiwehi. Whether or not they had the right to sell or not, they were clearly Ngatiwai and they resided on Northland's east coast opposite the Poor Knights Islands in the Whangaruru and Whananaki areas.

Figure 3.11 Roll plan 8 made in the 1860s showsMāori land blocks from Mimiwhangata to Whananaki. The red box is an enlargement shown in figure 3.12. [Map downloaded from Landonline, Land information New Zealand]

Figure 3.12 Enlargement of roll plan 8. Modern names of bays mentioned in this chapter have been added. Red dots show the burial site at Roimata Pt and the location of the kumara pit sites reputed to belong to the Poor Knight Islanders (Q05-40 & 43).[Map downloaded from Landonline, Land Information New Zealand]

When were the islands occupied?

European accounts do not document any confirmed presence of Māori on the Poor Knights Islands prior to their abandonment in 1823. Even indirect evidence of anthropogenic use through the colour (brown) of the island is fragmentary and open to other interpretations. What is clear from archaeological and traditional sources is that by 1823 the islands had a resident population of 300-400 people. Contradictions appear when the length of occupation is discussed. On one hand the Fraser ethnography based on later accounts by local Māori talks about many generations of use. In contrast court evidence presented by Hana Paengatai says that Te Tatua was the first and last chief to occupy Tawhiti Rahi. Assuming that both accounts are correct this suggests that the late appearance of a chiefly presence on the island reflects a significant change in the nature of settlement from a non-resident to a resident population occurring late in prehistory. There is well documented evidence from historical and traditional sources that human occupation of the Poor Knights ended after both Aorangi and Tawhiti Rahi Islands were attacked by Te Hikutu from Rangihoua between the 10th and the 16th of December 1823.

Why were the islands occupied?

Historical documentation does not directly address why the islands were initially utilised by Māori but it is reasonable to assume that it was due to the presence of rich natural food resources and high potential for introduced horticulture. Rich fisheries were hinted at in the traditional histories but it is Fraser's ethnography that identifies both the importance of traditional Māori horticulture along with the seasonal harvesting of 'Rako' mutton-bird that was highly valued on the mainland. The intensity and nature of use appears to change late in prehistory. The islands inaccessibility may have changed from being a liability to an asset in that the encircling cliffs provided an easily defendable refuge for people needing protection from the escalating inter-tribal conflict. Associated with this is a fundamental change from the islands being used as a low intensity outlier garden and wild food resource area by a non-resident mainland population, to high intensity use by a large resident population.

3.3 Traditional and Historical Account Summary

Māori traditional history points to initial discovery and naming occurring early when founding ancestors could still recall their Pacific origins (Piripi 1961; 1962a-c). The nature of land use at this time is not specifically mentioned, but there are later references to gardening (Fraser 1925). Māori Land court records for Great Barrier mention a number of times that the period following

Ngati Rehua's conquest of Great Barrier, sometime around the end of the 17th century, was a time when Ngatiwai were settling and making regular use of the resources on the islands between the Tai Tokerau mainland and Aotea (Great Barrier Island).The island society described by Fraser reflected the last period of human occupation, which his Ngatiwai informants said had lasted for 'many generations'. At this time exploitation of the horticultural potential and mutton-birding opportunities was important enough to record, along with necessary connections to the mainland which provided resources not available on the island such as totara wood for buildings (Fraser 1925). Native Land Court records from the 1920s and current online Tatai records independently confirm the names of Te Tatua (from the Whangaruru-Whananaki coastal area) and his wife Te Oneho (from Takahiwai in Whangārei Harbour). The evidence points to Te Tatua's settlement of the islands occurring around 1800 in the early historic period. Court testimonies identify that Te Tatua was the first rangatira (chief) to permanently live on Tawhiti Rahi Island. At this time the islanders were probably self-sufficient, growing crops such as kumara, taro, yam and gourd and had immediate access to the surrounding rich marine resources that would have provided them with most of their kaimoana (food of the sea) needs.

Since 1823 relatively few people have visited the Poor Knights Islands. This was due initially to the tapu placed there by Te Tatua following the abandonment of the island, and the subsequent series of increasingly protective pieces of government legislation that in effect created a "European tapu". When scientific interest in the islands began in the early 1900s, visitation was focused mainly on the smaller southern island of Aorangi where access and visibility were good due to the pig induced removal of lower storey vegetation. At this time Tawhiti Rahi was covered with near impenetratable thickets. It was only in the 1940s when the forest canopy formed, and the reduced light on the forest floor inhibited understorey vegetation, that visibility improved and access was possible. All these factors have contributed to protect the archaeological features from damage and so create the apparently pristine archaeological landscape that is visible today.

This review of historical knowledge associated with Tawhiti Rahi Island hints at a long period of human history but one whose nature changed over time. An early and long established seasonal use of the island as a garden outlier (see Chapter 4) and mutton-bird resource was made by a non-resident population. Late in prehistory a number of sources suggest inter-tribal conflict and defeat at the hands of Ngapuhi on the mainland encouraged some Ngatiwai to settle permanently on these island refuges (Piripi 1961; Slocombe 1994; Hetaraka pers comm., 2005). The implication of this is that the 'many generations' of island use reported by Fraser are real, but that a fundamental change in the nature and intensity of settlement occurred with the chiefly arrival of Te Tatua and Te Oneho when a larger resident settlement of perhaps 300-400 people was established. If correct, then in the 20-30 years between Te Tatua's arrival and the post attack abandonment of the island in 1823, the islanders had, within one generation, built the large scale and extensive stone and earthwork structures visible on the ground today.

This idea of a dramatic settlement change late in prehistory is not contradicted by the accounts and charts made on the number of European ships that sailed past the islands in the 18th and 19th centuries. However the European history of ship visits is remarkable for what it doesn't say about the human history of the islands, in that there are no eye-witness accounts of human settlement prior to 1823. With such a potentially short period of occupation, it is possible that the voyages of the Endeavour (1769) and the Royal Admiral (1801) may have predated the start of this late period settlement event, while those of the Astrolabe (1824) and the Dromedary (1833) definitely postdated the attack and subsequent abandonment of the island group in 1823. Only Nicholas' account of 1815 while on board the Herald with Marsden is in the relevant time period, but even then it is unclear whether the ship was close enough to see human activity. Therefore the idea that the extensive evidence of Māori occupation visible in today's archaeological landscape may reflect a single, coordinated and planned occupation event that occurred sometime after Cook's visit of 1769, cannot be ruled out by the information currently available in the historic record.

To test this premise further we need to look at environmental science and archaeology – the other two strands of research in this multi-disciplinary approach that are discussed in Chapters 4 and 5.

Chapter 4: Environmental Science

4.0 Introduction

This doctoral research takes a multi-disciplinary approach to island history whereby a core of archaeological perspectives and techniques are informed by historical records and environmental science. This chapter specifically examines our understanding of constrained island environments and along with the use of earth sciences can provide data that both directly, and by proxy, identifies anthropogenic events over time.

In Chapter 1 the rationale behind choosing Tawhiti Rahi as a case study was set out. The rationale identified three conditions present on this island that make it a useful test case for identifying and measuring cultural change. The first condition is that it was arguably a peripheral environment for Māori but was nevertheless utilised extensively at certain times. This suggests that it had moved both into and out of mainland social systems in a way that might be visible in the archaeological record. This possibility is examined in Chapter 5. The second condition is that the abandonment of the island by people in 1823 was both abrupt and permanent and by chance left behind an unusually well-preserved and potentially contemporaneous archaeological landscape whose end is historically well documented. This condition is examined in Chapter 3. The third condition is that there was long term bio-geographical isolation of the island before human settlement started and then two centuries of near isolation after that settlement ended. This provides an environmental 'control' against which anthropogenic changes to the natural environment can be identified, measured and timed. This then is the focus of Chapter 4.

In this chapter the environment of Tawhiti Rahi Island is discussed in three parts. Part I reviews our knowledge of Tawhiti Rahi Island and discusses the geology and resulting topography, the biology and the current vegetation with reference to potential for Māori use. Due to the circumscribed nature of this offshore island, a number of environmental 'presence' and 'absence' scenarios are identified that at differing times can be constraints and/or opportunities for the maritime people who utilised this island. In Part II the island's vegetation history is reconstructed. The main environmental research tool used for this reconstruction is palynology, whereby a sediment core was taken and the pollen within it removed, identified and counted so as to reconstruct an island specific vegetation history that can be used to indirectly inform us about the nature and timing of human activity on the island. The pollen study undertaken is discussed and a description of the resulting vegetation sequence obtained from both the pollen and macroscopic charcoal is given. As part of this process, radiometric dates were taken from core sediments and an appropriate age/depth model presented. Finally, based on the pollen sequence and the charcoal in the core, implications for the timing and nature of human settlement are made.

Palynology as an established methodology for recreating ancient vegetation histories is the only earth science used in this environmental research. This was carried out by Dr Janet Wilmshurst and colleagues from Landcare Research in 2008 and the results published last year (Wilmshurst et al 2014). Two other complementary methodologies that might identify introduced cultivars against this background of native vegetation were considered but not used. The first was starch grain and plant cuticle analysis (Horrocks 2004; Horrocks et al 1999, 2000, 2001, 2003, 2004a, 2004b, 2005, 2007a, 2007b, 2008a, 2008b, 2011). This is an existing methodology that is claimed to identify Polynesian cultigen. However it still lacks a comparative database of native plants to substantiate the exotic plant identifications and so was not used here. The second methodology had Dr Jamie Wood of Landcare Research using DNA analysis to develop genetic 'finger prints' that would distinguish and identify individual exotic cultigens from a background of indigenous species (Wood, pers.comm., 2013). However it too was not used because it is still in the early stages of development and has yet to show any substantive results (Woods 2014).

In part III, two of the 'presence' and 'absence scenarios' identified in part I are examined in light of what we now understand from the palynology. First, the absence of Polynesian kiore on any of the Poor Knights Islands during the prehistoric sequence and second, the presence of the European pig on only Aorangi in this group are discussed with regard to what they can tell us about the nature and timing of human settlement on Tawhiti Rahi.

4.1 Part I: Environment

The Poor Knights Islands are situated in the coastal waters off the northern east coast of New Zealand. This warm temperate climatic zone is suitable for prehistoric horticulture and as discussed in Chapter 1 we follow the previous research in defining this zone as extending along the east coast of the North Island from the Three Kings Islands in the far north to Moutohora Island in the central Bay of Plenty to the south (Cochrane 1957; Edson 1974) and contains 4163 islands including stacks, shoals, sandbars and rocks that range from less than 100 m to 56 km off the mainland coast (Taylor 1989 Table 1). For the purposes of this environmental science chapter a subset of this study area is made that is limited to offshore islands (or island groups) greater than 5 km from a larger land mass and which are 30ha or larger in size and thus able to support a resident human population.

4.1.1 Environmental Overview of the Poor Knights Islands

The Poor Knights Islands are an internationally significant island group for their geology, terrestrial fauna and flora and rich maritime resources. The land is protected by a nature reserve designation under the New Zealand Reserves Act 1977, while the surrounding sea area is protected by a maritime reserve status under the New ZealandMarine Reserves Act 1971. The islands lie 20 km off Northland's Tutukaka coast and consist of two main islands, Aorangi (100 ha) and Tawhiti Rahi (150 ha) as well as ten smaller stacks or vegetated islets (Harper 1983: 299). The islands are composed of rhyolitic lavas, flow breccias and tuffs. They possibly represent the northern part of the tectonic line which further south is marked by the rhyolite outpourings at Moko Hinau, Great Barrier, Cuvier and Colville islands. Without exception all the islands are steep and precipitous, with cliffs that are over 100m in height in places. The climate is temperate, with rainfall occurring mostly in summer and in lesser amounts than comparable areas on the adjacent mainland. Seas surrounding the islands provide a thermal sink that creates a 'marine effect' that limits any overnight drop in air temperature so that frosts do not occur. Both the larger islands of Aorangi and Tawhiti Rahi currently have a continuous vegetation canopy of pohutukawa *(Metrosideros excelsa)* and a range of shade tolerant scrub species in the understorey below. The vegetation on the smaller islands and stacks is limited to a low covering of salt tolerant shrubs and grasses.

4.1.1.1 Topography

Measuring 2.7 km north-south and 100-800m west-east, the topography of Tawhiti Rahi Island is a direct result of its volcanic origin. The most visible characteristic that dominates the landscape is the vertical cliffs that form the coastal margin. Visible from many kilometres away, these cliffs vary in height from 10 to 180m and form a significant barrier to access. The northern three-quarters of the island is a high table-top plateau surrounded by the tallest of these cliffs. It measures 1.7 km north-south and 300-500m west to east, and is characterised by three gently sloping ridges that separate four small and shallow stream valleys. At various places around the margins of the plateau, ridges run down to the sea in all directions except southwards, where an escarpment drops abruptly down to the southern lowlands (Sumich 1956:64). A cross section from coast to coast through this plateau shows steep and vertical external cliffs to both the west and the east, whose tops are higher than most of the internal ridges and all of the shallow stream valleys (Figure 4.1). This topography results in a micro-environment that is sheltered from most

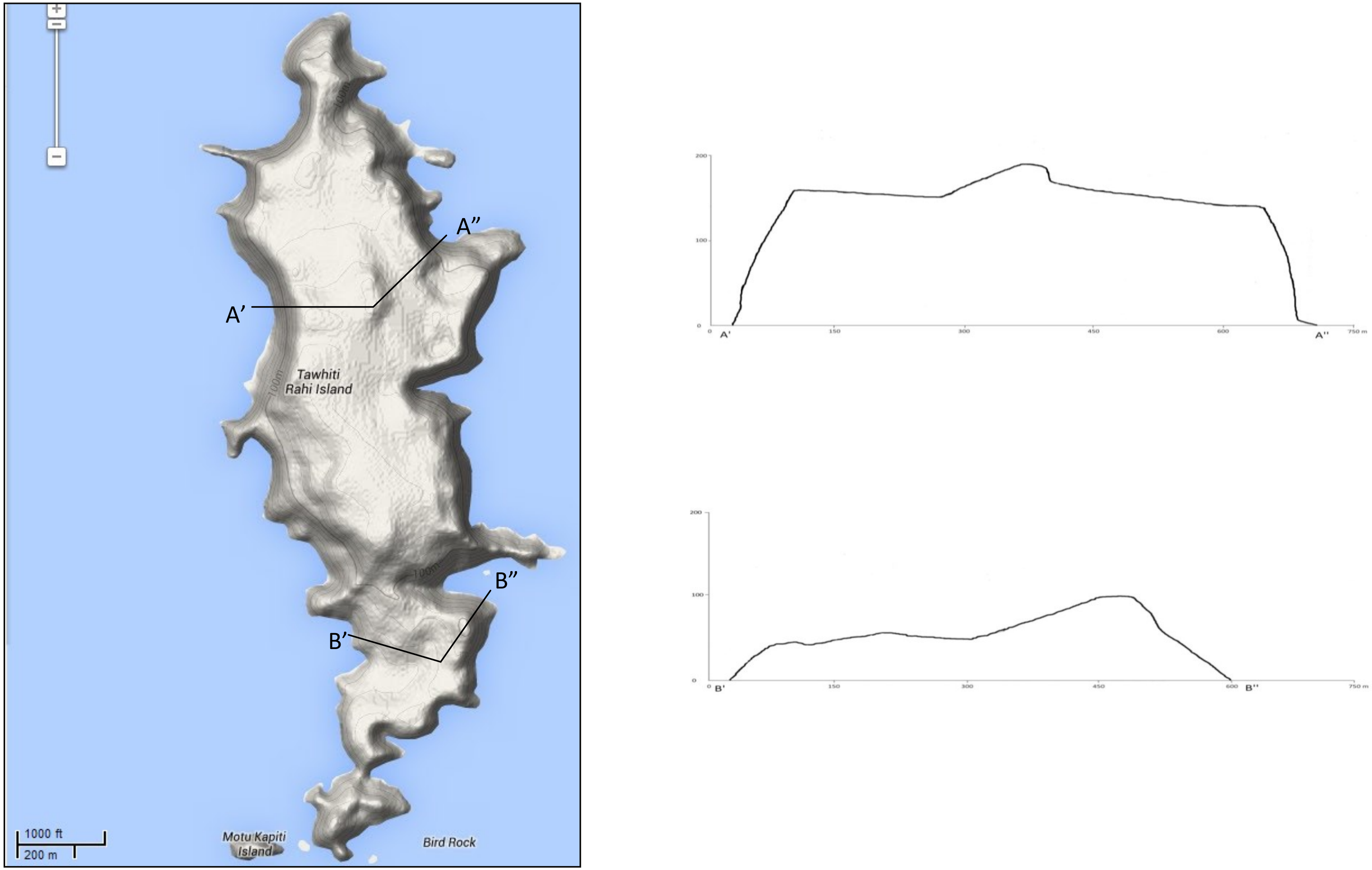

Figure 4.1 Tawhiti Rahi island shade terrain model showing two contour profiles, one across the northern plateau (A-A'') and the other across the southern lowlands (B-B''). Lat 27.988056, Long 86.925278: Google maps terrain shade model 27th March 2015]

weather events over most of the plateau. It is only at Cave Bay where the ground slopes down to the east and the cliff top ridge is absent that this protection is missing. It is telling that it is only here on the island that the plateau vegetation gets progressively lower and more stunted due toregular exposure to salt- ladeneasterlywinds. The southern lowlands form the southern quarter of the island. At most it measures 900 m north-south and 500 m west to east. It too has vertical boundary cliffs, but here they are much lower due to the deeply folded nature of the ground surface. In general the ground is moderate to steeply sloping, but some near-level ground is present on the saddle to the north at the foot of the southern escarpment. The primary topographical feature here is a centrally located moderate to steep catchment valley containing a permanent stream. This catchment is bounded by a cliff top ridge and 80m tall vertical cliffs that drop to the sea to the east, and by a sheltered bay (Camp or Shag Bay) with low encircling cliffs to the west. From its source high up in this catchment, Charles Stream runs first south then west before dropping in a 10m waterfall into Camp Bay. A cross section from coast to coast through the southern lowlands shows that the northern and southern arms of Camp Bay provide protection from north-west and south-west winds, and only if the wind is from the west is salt spray an issue for the vegetation. The steep cliffs on the east coast protect the vegetation in this area from salt laden winds, except in extreme cyclonic conditions.

The rarity of permanent water courses on the island is related in part to the highly permeable nature of the volcanic soil and underlying geological strata. As a result of the dryer coastal climate and a dominance of ground moisture originating from fogs (see climate discussion below) and it is rare for streams to have a measurable flow except when major rain events irregularly occur. These circumstances are borne out by the lack of water erosion in most streams and by the author's observation that visible stream flow only occurs after several days of continuous steady rain.

4.1.1.2 Geology

The surface of Tawhiti Rahi Island is covered with volcanic ash and tephraejected from the ancient rhyolitic volcano that created the island group. First described as rhyolitic breccias (Bartrum 1936), the rock is now more commonly identified as rhyolitic tuff formed from sub-aerial and/or marine deposits laid down during the course of the eruptions. As the island is traversed, the surface rocks encountered vary widely in size from 10 cm cobbles up to boulders many metres across, as well as large outcrops. Prof Michael Palin of the University of Otago Geology Department noted that eruptions from rhyolitic volcanoes of the type found at the Poor Knights Islands characteristically produced surface deposits of various sized breccias' (Palin pers. comm. 2013; Appendix 5:i). All of the local rhyolitic lithic material found on Tawhiti Rahi was deposited through ash fall and/or ignimbrite (pyroclastic) flow events. The ash fall of fine material would be thickest near the eruption centre and would be susceptible to subsequent erosion events causing re-deposition across the landscape. The 100-150 °C temperatures involved in ash fall events did not significantly modify this material, though it is often found with earth and plant components mixed in. Post-deposition processes involving water percolation and compaction lead to localized concretion (See Chapter 5 Hearth site excavation). The ignimbrite flows on the other hand were formed from a collapsing column of volcanic material that travelled at high speed at ground level away from the eruption centre. Both large and small sized material could be widely distributed by such flows, and the very hot nature of these events (often at 1000°C) caused significant and easily identifiable welding to the parent material.

Professor Palin's examination of representative samples of the volcanic rock found on Tawhiti Rahi Island identified a post depositional process of intense hydrothermal alteration characterised by silicification (Appendix 5i; see also Wodzicki & Bowan 1979:752). His preliminary assessment noted that that the varying degrees of 'white' colour in the island's rock is due to the parent rhyolitic rock material being partly or totally replaced by silica, in a post-depositional process when warm silica-rich water permeated the ground mass formed by ash fall or pyroclastic flow. As this water cooled it replaced the parent material with silica which progressively became lighter in colour as the silica content increased. Due to this inflow of silica, some of the rock also has quartz, alkali and/or feldspar present that can be seen as veins or inclusions in and around the parent rhyolitic tuff. Where this replacement process has been completed, the rock is distinctly white and has in places a 'porcelain' like appearance. A detailed discussion of the rhyolite, breccia and silicified rocks that occur naturally on the surface of Tawhiti Rahi is given in Appendix 5i.

The soils that formed on this geological base have not been quantitatively studied, but have been classified in the general literature as yellow brown steep land soils of the Marua-Rangiora type characterised by poor drainage and low fertility (Gibbs 1968: Map 3). However visitors to the island describe a very different environment, with well drained silty soils of high humic content and high fertility. Cockayne for example thought that the rich foliage on both Aorangi and Tawhiti Rahi Islands was a direct result of this high fertility (Cockayne 1905:354). It is likely that at least some of this high fertility is due to enrichment from guano dropped over the island by ground-nesting colonising seabirds (Atkinson 1986:28). Experimental sweet potato cultivation on the Wairarapa coast confirms that the kumara was ideally suited to the well drained silty soils found in Tawhiti Rahi. Not needing high fertility to grow successfully, the guano induced fertility could have allowed for shorter fallow requirements than is usual for traditional cultivation (Burtenshaw and Harris 2007).

4.1.1.3 Climate

The broad climatic conditions of Northland are seasonal, with warm and humid warm temperate summers and mild temperate winters with few frosts. Temperatures range from 22-26 °C in summer to 14-17 °C in winter. Rainfall in the low-lying areas ranges from 1200 to 1700 mm, and prevailing winds are from the south-west. Tropical depressions that are the remnants of tropical cyclones periodically pass down the east coast in summer, bringing gusty winds and heavy rainfall (Orange 2012). The Poor Knights Islands are located in the sheltered waters off the east coast of Northland. The specific climatic conditions of the island group are not published, but a general assumption in the literature is that coastal islands in this locality are warmer, have less rain and are more humid than the mainland due to the seasonal presence of the tropically originating East Auckland current (Edson 1973:64). Unpublished data collected from Tawhiti Rahi Island by Professor Christa Mulder between February 2005 and January 2006 included mean daily temperature of 14.85°C (that is four degrees higher than the mainland), a mean daily dew point of 13.81°C, an absolute humidity (in g per m3), and a relative humidity (in %) that ranges from 77 to 104°C (Appendix 9). Examination of Mulder's data supports two of these assumptions by showing that the island is warmer and more humid than the mainland. A summary of her results on humidity indicate that the average relative humidity ranges from 87-90% in February to April and 99-102% in May to January. This implies that dew production on the island caused by overnight temperature decrease occurs throughout the year but is reduced during the summer months of February to April. Observations by the author of cloud or fog over Tawhiti Rahi (Plate 4.1) were noted both from the mainland and from the southern lowlands of the island between May to November over many years. This phenomenon is related to the high humidity and to the heat differential between the island's land mass and the ocean.

It is possible that there is an orographic rain effect occurring here as well. Such rain occurs when air is forced to rise over a landmass and then cools and condenses into clouds (Whiteman 2000). Although this effect is supposed to occur above 300m (University of Wisconsin 2008) and the island's northern plateau is only 180-190m high, it is argued that it probably does happen here due to the >150m high vertical cliffs magnifying the effect and causing winds from both the west and east to rise vertically to a significant height. Anecdotal support for this effect comes from observations made by the author while working on the high plateau gardens during windy days when strong winds from the east were very loud but did not disturb the 10m high forest canopy above us due to this upward deflection.

Early publications and recent experimental cultivation of traditional sweet potato in the Palliser Bay archaeological gardens, has confirmed that kumara are easily damaged by frost, are drought tolerant and are very capable at catching and utilising dew (Best 1925; Colenso 1880; Walsh 1902; Burtenshaw and Harris 2007). Islands like Tawhiti Rahi experience lower rain fall than the mainland, have higher orographic (dew) moisture due to the heat sink differential between the land and the sea, and unlike the mainland are not subject to frosts due to the ameliorating influence of the marine effect. Climatically, Tawhiti Rahi is ideal for sweet potato cultivation.

Plate 4.1 Citadel and northern plateau in cloud during a winter rain event. Direct data on rainfall suggests that Tawhiti Rahi enjoys less rain than the adjacent mainland. This deficit, especially in the summer months, is offset by the fogs and cloud cover that occur year round. [Graham 2008, Photo07-7A]

4.1.1.4 Fauna

Although probably connected to the mainland during most of the earlier periods of extreme sea level lowering associated with climate cooling, the last period of glaciations was not as extreme and so unlike other northern offshore island groups, only the Poor Knights and Three Kings Islands remained separated from the mainland (Watt 2012:287). This has resulted in noticeable endemism in both the fauna and flora. By chance or design the Poor Knights Islands have subsequently remained isolated from most of the animals introduced into New Zealand during the last 700 years of human settlement. The lack of kiore, the Polynesian rat, and all European sourced rodents and domestic animals has ensured that many native species now extinct on the mainland are still present on Tawhiti Rahiincluding tuatara (*Sphenodon*), giant weta (*Deinacrida fallai*), flax snail (*Placostylus hongii*), many species of lizard and a giant centipede (*Cormocephalus rubriceps*) The late presence of European pig on Aorangi, the only other major island in the group, has caused some native species extinctions to occur but overall, species numbers are still greater on the Poor Knights group of islands than that found on the adjacent mainland.

The most common form of vertebrate life on these islands is birds (Kinsky and Sibson 1959). Although land-based birds such as the spotless crake, a small semi-resident population of kahu, the Harrier hawk (*Circus approximans*) and a large population of korimako, the bellbird (*Anthornis melanura*) (now extinct on the adjacent mainland) are present, it is the seabirds that dominate. Millions of sea birds, including nine species of petrel flock to the island to breed between October and May. The most numerous of these are the rako (Buller's Shearwater), a trans-equatorial migrant that ranges over much of the Pacific as far north as the subarctic waters of Kamchatka and the Aleutian Islands, but which returns to breed solely on the Poor KnightsIslands. By the 1980s there was estimated to be 2.5 million Buller's Shearwaters on seven of the 12 islands and stacks in the main island group, with the largest colony being on Tawhiti Rahi (Harper 1983: 299). The fledglings are rich in fat and like various other petrels found around New Zealand, were seasonally collected as 'mutton-birds' by Māori who knew it as the 'rako' (Harper 1983:301). The islands support this large number of birds because of the rich marine environment. Along with the range of fish expected in New Zealand waters, the east Australian current, which becomes the east Auckland current, seasonally brings warmer water along with a different group of tropical fish normally found in waters off southern and eastern Australia. This combination of temperate and tropical fish species creates one of New Zealand richest maritime environments, with 1259 marine species so far recorded, many of which have been utilised by Māori and European alike for many generations (Sim-Smith & Kelly 2009:2). Directly and indirectly, these fish and the seabirds depend on the large volumes of crustaceans such as krill that arrive with this current.

The Buller's Shearwater was known for a long time before its only breeding ground on the Poor Knights was identified in 1924 (Falla 1924). Originally identified in early reports as rare and endangered due to only a few hundred breeding pairs being found, this number was progressively increased to 2.5 million as visiting ornithologists systematically surveyed the island. This increase in reported numbers parallels the development of the pohutukawa canopy and it is unclear whether the initial small population reported reflected the difficulties scientists had in accessing Tawhiti Rahi due to thicket vegetation that dominated prior to the canopy forming or whether it reflected a real increase in bird numbers. Other data sources suggest both processes were occurring. These ancient breeding grounds predate human arrival, but once settled by Māori, the bird was ethnographically recorded as being managed and conserved as an important food source (Fraser 1925) albeit having a reduced range limited to the coastal cliff fringe. Once people abandoned the island in 1823, this relic population increased as is shown by the expansion of bird burrows into some abandoned archaeological sites (e.g. R06-90), and into risky locations such as the middle of the intermittent Buller Stream bed. Studies on the adjacent Aorangi Island made following the eradication of pigs in 1936 also showed that the Buller's Shearwater outcompetes the smaller fluttering shearwater by arriving sooner to nest and aggressively taking over existing burrows (Peirce 2004 pers.comm.). The fact that these birds have recolonised abandoned archaeological sites (Chapter 5) confirms that their population was limited during Māori occupation, but grew numbers grew rapidly following human abandonment of the islands and the appearance of a canopy forest.

Ground dwelling seabirds with fat rich young were originally found throughout New Zealand. Within a few centuries after Polynesian arrival, mainland colonies declined rapidly or disappeared completely due to extensive vegetation changes associated with anthropogenic fires, direct predation by Māori, and most significantly the introduction of the Polynesian rat kiore into this unprotected environment (Wilmshurst & Higham 2004). By default offshore populations of bird colonies that survived on rat-free islands would become progressively more important as mainland mutton-bird resources disappeared. Exactly how important the Buller's Shearwater was to Māori is unclear, but they were significant enough to be named "rako", to be described as being larger and more tasty than other mutton-birds, and to have their distribution in the coastal fringe along with their management as a food resource, explicitly mentioned in the Poor Knights ethnography (Fraser 1925). A broader discussion on rat-free islands and its implications for sea bird populations and Māori settlement in general is made in Part III of this chapter.

4.1.1.5 Flora

Identification of vegetation on Tawhiti Rahi Island began in 1905 when Captain Bollons reported to Cockayne that the southern end of the island was covered with a coastal native bush, with shrubby pohutukawa (*Metrosiderous excelsa*) and to a lesser extent kawakawa (*Piper excelsum*formerlyknown as *Macropiperexcelsum*) being the dominant species (Cockayne 1906; Oliver 1925).

Pohutukawa in particular forms the primary single layer canopy that today covers and shades the whole island. In places, especially in the south which has a history of recent fires (Appendix 6) and in the central eastern area that are exposed to salt laden winds, this canopy is only one to two metres high and often gives way to a range of cliff edge species including flax (*Phormium tēnāx*) and sedges. However in the sheltered northern valleys and along the central ridge, the pohutukawa canopy can reach 8 to 15m in height. A detailed account of the vegetation species present on the Poor Knights Islands can be found in a number of publications (Edson 1973: App 2; Cochrane 1954; de Lange & Cameron 1999).

A study of succession processes was made on a number of North Island offshore islands by Atkinson in 2004. He noted that the original vegetation on all islands was destroyed by human-induced fires, and that the process of succession was dominated by either kanuka for a short period or by pohutukawa for longer periods up to several centuries (Atkinson 2004:181). Records from successive scientific visits show that the vegetation on Tawhiti Rahi has undergone rapid change and is consistent with Atkinson's model. From the extensive areas of manuka *(Leptospermum scoparium)*, open ground and dominant areas of astelia *(Astelia trinervia)* as an understorey plant reported in the 1920s (Bollons 1922), the island now is dominated by pohutukawa. The fact that this is still just a single layer canopy implies that this process of change is not yet complete, and a stable climax forest has not yet been achieved. It is assumed that the shrubby and impenetratable thickets of mostly young pohutukawa noted by Fraser in 1924 gave way to a canopy of pohutukawa sometime after the 1940s. Thus by the time Leahy and Nichol visited Tawhiti Rahi in 1964, they were able to identify archaeological features that were too overgrown for Fraser to identify (Fraser 1924; Leahy & Nichol 1964). This is in sharp contrast to the adjacent Aorangi Island, where pig browsing had kept the understorey clear of obscuring vegetation all through the 20th century (Fraser 1924, 1925). Visits by the author from 1999 through to 2010 have shown the understorey visibility on Tawhiti Rahi to have increased from an average 5 m to 10 m as more shrubs are progressively shaded out by the thickening and deepening pohutukawa canopy.

Trees with either direct or indirect food resource value to Māori that are still present on Tawhiti Rahi include miro *(Prumnopitys ferruginea),* cabbage tree *(Cordyline australis)* and karaka *(Corynocarpus laevigatus)* (Stowe 2007). The first two are now limited to the southern lowlands, and maybe relics of the period when Māori occupied the island. Karaka is found in a number of areas, especially near archaeological sites on the central plateau, and may have been deliberately planted although bird dispersal cannot be ruled out (Atkinson 2004:183). Considering the current research on karaka and its importance in prehistory as a 'super nut' tree crop cultivated on the Chatham Islands (Maxwell 2014), it is very possible that it had a similar but minor supporting role to horticulture on the Poor Knights Islands. The following section discusses the reconstruction of the Poor Knights Island vegetation based on the analysed pollen sequence, undertaken to identify other plants of resource value to Māori that were once present here.

4.2 Part II: Palynology and Microscopic Charcoal

The identification of often abundant pollen grains obtained from coring undisturbed sediments are used by palynologists to reconstruct a broad brush picture of the changing environment and sometimes the climate of a given place. For archaeologists such a vegetation record reconstructed from the pollen is a useful proxy that provides indirect evidence for understanding the interactive relationship of people in a given environment (Pearsall, 2000:249). In continental localities where culturally diverse groups of people have interacted with an environment over long periods of time it is difficult to first identify a pre-human vegetation baseline and then to establish which of the cultural groups were responsible for changes subsequently identified in the environment (Kirch et al.,1987). However in the Pacific this human-environment relationship is less complex and easier to interpret due to (i) islands being uninhabited until relatively recently, (ii) these islands being abruptly settled by a single broadly homogenous cultural group, and (iii) this cultural group being subsequently isolated on these islands for a significant period of time until European arrival in the area.

In Polynesia and Near Oceania studies using palynology based vegetation reconstruction have been used for studying the interaction of people and the environment with regard to dating first settlement and understanding the subsequent changes in the environment (Flenley 1994; Haberle 1996; Prebble and Wilmshurst 2009; Allen and Kahn 2010). It has been successfully used to document the introduction of domesticates (Horrocks and Bedford 2005) and date the arrival of agriculture in Papua New Guinea (Haberle 1996; Haberle *et al*, 2012).

The study area of the Poor Knights Islands is known to have had a complex built landscape that is likely to have involved significant environmental modifications and has a well-documented end date to human settlement. Attempts to take pollen cores from both Aorangi and Tawhiti Rahi were made in 2008 with the aim of identifying a detailed vegetation history to engage with the thesis questions of the date of first human arrival and the nature of human use.

Part II of this chapter reviews palynology in New Zealand and in the temperate offshore island region off the North Island's east coast. Then a description is given of the palynological study to be carried out on these islands, including an outline of the expected goals, as well as identifying the specific difficulties faced in obtaining an intact depositional pollen sequence on these circumscribed islands. The methods employed in sampling, laboratory analysis, counting and radiocarbon dating are then discussed. Finally a summary of the palynological results is presented.

4.2.1 Pollen Analysis and its Archaeobotanical Application in New Zealand

The use of charcoal and pollen as a proxy to determine when human settlement first became visible in New Zealand history was proposed by McGlone (1983). He argued that the key signals for anthropogenic deforestation action were (i) an abrupt and ongoing increase in macroscopic charcoal frequency and intensity, (ii) a sudden decrease in forest species taxa that then remains at a low level, and (iii) an associated increase in early successional species – especially the fire triggered bracken fern (*Pteridium esculentum*). Archaeologists in partnership with palynologists have analysed and interpreted palynological records to reconstruct vegetation histories in many places around New Zealand. Understanding pre-human vegetation base lines and identifying both natural and anthropogenic fire regimes has enabled the timing of the human settlement in New Zealand to be identified (Mildenhall and Moore, 1983; Elliot *et al.,* 1995; McGlone and Basher, 1995; Wilmshurst *et al.,* 1997; Newnham *et al.,* 1998; Ogden *et al.,* 1998; Giles *et al.,* 1999; McGlone and Wilmshurst, 1999; Horrocks *et al.,* 2000; Horrocks *et al.,* 2001; McGlone, 2001; Horrocks and D'Costa, 2003; Horrocks, 2004; Horrocks *et al.,* 2004a; McGlone *et al.,* 2005; Stowe, 2007; Butler, 2008; Campbell and Hudson, 2008; Matisoo-Smith *et al.,* 2008; Sutton *et al.,* 2008; McWethy *et al.,* 2009; Williams, 2009; Perry *et al.,* 2012; Wilmshurst *et al.,* 2014).

In the New Zealand context, radiocarbon dates for initial human arrival consistently coincide with dramatic changes in the vegetation patterns that match McGlones 1983 criteria for anthropogenic action (Perry *et al.,* 2014). This pattern even has some localised chronological delays attributable to slightly later human expansion into less optimal locations (McWethy *et al* 2009; Williams 2009). Unlike archaeological methods that require a specific early site to be dated to determine earliest settlement, palynology uses significant changes in macroscopic charcoal and vegetation patterns as a proxy for human presence somewhere in the pollen catchment area

(McGlone, 1983; McGlone and Basher, 1995; McGlone and Wilmshurst, 1999; McGlone, 2001; Sutton *et al.,* 2008; McWethy *et al.,* 2009; McWethy *et al.,* 2010).

4.2.1.1 Identifying Anthropogenic Fire

In simple terms fire events in the vegetation record can be identified in the sediment core through the presence of macroscopic charcoal and through changes in the pollen counts that reflect a dominance of early successional species. Differentiating whether these fire events are caused by natural events or were deliberately lit by people can be difficult when examined in isolation from archaeological evidence (Butler 2008: 123; Higuera *et al.,* 2010; McWethy *et al.,* 2010) and this has been a source of debate for archaeologists holding opposing positions on New Zealand's 'short' or 'long' chronology hypotheses (Anderson, 1991:782-3; Sutton *et al.,* 2008). Butler (2008: 123) suggests that in the absence of supporting archaeological evidence it may be premature to assume that fire is anthropogenic. Supporters of a possible longer chronology of human settlement for New Zealand (pre 1200 AD) use supporting evidence from *Rattus exulans* (kiore) dated to 2000 BP (Holdaway, 1996) that is a known commensal of Polynesian explorers (Sutton *et al.,*2008:113-114). This dating of kiore from a single non-cultural site is however highly contested (see Wilmshurst *et al.,* 2008: 7677) and currently there is no accepted direct archaeological evidence of human settlement to support the long chronology hypothesis.

So what is the likelihood of non-cultural fires in the pre-human New Zealand environment? Butler argues that there are only a few natural sources of ignition in New Zealand's endemic forests and concludes that unlike Australian vegetation, New Zealand forests were not adapted to fire (Butler, 2008). Support for this position comes from macroscopic charcoal reconstructions that suggest that prior to human arrival the occurrence of natural fires was uncommon (McWethy *et al.,* 2010; Perry *et al.,* 2014). If fires in pre-human New Zealand were unlikely to be of natural origin, then by default the dramatic increase in fire events after 1300 AD - when direct archaeological evidence of human presence becomes common - will nearly always be attributable to anthropogenic action. William's meta-analysis of pollen cores identified that remote inland localities in wetter environments burning events were delayed up to 200 years after humans firstarrived in New Zealand. In contrast, the easily accessible coastal and river areas in the eastern rain shadow experienced anthropogenic burning immediately after human arrival (Williams, 2009). If Williams' model is true, then islands along the east coast would be much more susceptible to burning than the mainlands (Whitlock *et al.,* 2010: 14) and so deliberate burning on small and seasonally dry east coast islands such as the Poor Knights should easily de-vegetate most of the landscape. Any remnant coastal fringe plants unmodified by these fires should provide only a small and species limited seed source for subsequent natural recovery.

During prehistory, the vegetation on the adjacent Northland mainland experienced extensive and ongoing modification through the use of anthropogenic fire (Elliot et al, 1995; 1998; Horrocks et al 2001). Today the presence of a consistently young *Metrosideros sp* forest over most of Tawhiti Rahi and Aorangi indicates that these islands are still recovering from an island wide fire event instigated by Māori late in prehistory. Small areas of even younger *Metrosideros sp* forest in the southern lowlands of Tawhiti Rahi are visible on early aerial photos as scrubland are probably from two historic fires that occurred at approximately 1923 and 1957 (Appendix 6). If this interpretation of the Poor Knights current vegetation is correct, then obtaining sediment cores with intact pollen sequences from these islands should allow avegetation history to be reconstructed through palynological and charcoal analysis, and for anthropogenic activity to be inferred.

Assuming anthropogenic fire is identifiable on the Poor Knights fromcharcoal in sediment deposits, then the question of whether this reflects local or distant burn events can be answered by the size of the size of the charcoal fragments recovered. Since water transported charcoal washing ashore from distant regions is not possible due to the encircling cliffs, only airborne charcoal needs to be considered. Generally, the smaller the particle size the further the charcoal sample can travel through the air. Previous studies suggest that particles 50 microns or larger in size will have travelled less than 200m (Kennedy and Clarke, 1985:80; McGlone and Wilmshurst, 1999:8) and must have an island origin, while particles 20 microns or less in size could travel hundreds or even thousands of kilometres and reflect fires originating anywhere in New Zealand or even Australia (Holt, 2008: 86-88). Charcoal recovered from sediment cores will therefore be recorded in three size categories. Two macroscopic categories (>125 microns and >250 microns) will reflect island based burn events originating less than 200 m from cores. The microscopic category (<1 micron) will reflect both island and mainland located fire (Whitlock & Larson, 2001).

The presence of macroscopic charcoal spikes in the sediment core should be mirrored by changes in the pollen record with first, an abrupt decrease in the pre-fire vegetation and second, a parallel increase in succession species. Succession species that benefit immediately from such fire events include sedges and grasses, kanuka species complex and ferns - especially the bracken fern (*Pteridium esculentum*) (McGlone *et al.,* 2005: 165). These species should be producing their distinctive pollen within 0-5 years of any given burn event. The presence of only successional species should be sustained for as long as the burn eventcontinues in the sediment record.

4.2.1.2 Climate or Human Induced Vegetation Change?

The model for the long chronology of New Zealand prehistory requires climate change as a causal factor when interpreting pollen and macroscopic charcoal core sequences (Sutton *et al.,* 2008:114). The model postulates a 'presence' and 'absence' scenario. The 'absence' scenario that has people arriving before 1200 AD, where they found the cooler and wetter climate had created wet indigenous forests that could not be burned. This explains why there is no anthropogenic charcoal record identified prior to 1200 AD. The 'presence' scenario has an El Nino dryer and warmer climate change event occurring between 1200 and 1300 AD, creating dry indigenous forests that could easily be burned. This explains the ongoing anthropogenic charcoal record that begins around 1300 AD (650 BP).

Supporters for the short chronology model argue that recent palynology research shows the last significant climate change event that occurred in New Zealand was associated with the end of the last glaciations around 13,000 years ago (McWethy *et al.,* 2010; Perry *et al.,* 2012; 2014, Wilmshurst et al., 2007). For the last 1000 years there have been no significant changes in moisture levels, wind direction and speed and temperature fluctuations that could explain the dramatic increase in fire events and deforestation that occurred since 1300 AD. They argue that there was no early wet phase and later dry phase and instead that the 'leeward' side of New Zealand had always been dry enough to burn before 1200 AD. They suggest that significant and ongoing fires did not occur before 1300 AD because the natural ignition sources were not significant enough to initiate major burn events. It is only around 1300 AD (650 BP) that a new and novel ignition source arrived in the form of archaeologically documented Polynesian settlers. It is the presence of these settlers who used fire as a deliberate tool to clear land that explains the constant burn events present in sediment cores throughout Māori prehistory (McWethy *et al.,* 2010; Perry *et al.,* 2012; 2014, Wilmshurst et al., 2007).

For the purposes of this thesis the short chronology of New Zealand' prehistory is assumed to be correct and that presence or absence of burn events will be directly associated with anthropogenic ignition. In this context the podocarp forest found on the larger Poor Knights Islands was unlikely to have been subject to major natural burn events, and so should have reached a stable climax state prior to human arrival. Being located on the dryer leeward part of New Zealand, and having well drained soils, the islands would have been easily modified by anthropogenic burning. Therefore a long vegetation history successfully reconstructed from a sediment core should show a sequence of changes starting with the pre-human climax vegetation, followed by a period of anthropogenic change sometime in prehistory, and culminating in the final phase of natural recovery that followed the well documented human abandonment of the Poor Knights Islands in 1823.

4.2.1.3 Previous Pollen Analysis in New Zealand's temperateoffshore Islands

The zone of temperate offshore islands located along the east coast of the North Island (see chapter 1) has seen only four pollen studies over the last 50 years, and none on the Poor Knights Islands. In 1961 an early pollen study on Hauturu Island (Little Barrier) identified but did not date species from two pits dug into peat deposits at the Te Maraeroa flats. Of the three stratigraphically separated samples taken from one pit, the top sample may relate to the period of Māori gardening while the two deeper samples probably represent pre-human vegetation. If correct, then the pre-human vegetation is associated with more conifer pollen and tree fern spores and a strong presence of rimu (*Dacrydium cupressinum*). Although charcoal was not measured, the increased levels of bracken fern and the near absence of rimu during the Māori gardening period suggests that forest clearance, presumably for gardening, was occurring (Harris, 1961; Fig. 21).

A second study was made on Moutohora (Whale) Island in the Bay of Plenty. Located at the far south of the offshore island zone (Chapter 1), a pollen study was made of this rat free island in 2008 (Wilmshurst, 1998). Poor pollen preservation meant that a detailed pollen analysis did not occur, but pollen slides were made and three phases were identified. Relative dates were ascribed using the stratigraphic presence of independently-dated tephra from the Tarawera and Kaharoa eruptions. Zone one at 55-95 cm is described as the early Māori period. Located immediately above naturally deposited and reworked Kaharoa tephra (650 BP), it contained small amounts of pollen that reflected a canopy of regenerating pohutukawa and some rewarewa (*Knightia excelsa*) along with an understorey of kawakawa and tree ferns. The continuous presence of charcoal and bracken fern suggests that the island vegetation was regularly burnt by Māori within a short 5-20 year cycle that forestalled tree saplings shading out and succeeding the bracken. Zone two at 22-54 cm is described as the late Māori period. It shows complex soil modifications that include the addition of tephra and charcoal and possibly organic material to improve its gardening potential by Māori. Zone three at 0-20 cm is the European period that is defined here by the Tarawera eruption tephra dated to 1886 AD. By 15 cm, pine pollen (*Pinaceae*) appears, and bracken begins to decline. In-washed clay at 12-14 cm, along with the presence of a native rush (*Baumea articulata*) and raupō(*Typha orientalis*) confirms that the swamp present today only formed in the recent European period (Wilmshurst, 1998: 3-5).

The third study was made on Mayor Island in 2002. Located in the southern third of the offshore Island zone, palynological research identified a 2900 year sequence that showed a significant change in the island's Podocarp vegetation starting around 450 BP +-84 (1500 AD) at a time contemporary with the Māori construction of pa and gardens (Empson *et al,* 2002: Figure 5).

Charcoal is present in the sample from this date to an undated point in the historic period when pine pollen appears. This wide charcoal presence most likely represents an ongoing series of burn events and is associated with the immediate disappearance of kauri *(Agathis australis)*, the decline and disappearance of rimu, the partial decline of podocarp species, and a dramatic appearance of bracken fern. The historic period identified by the pine pollen that extends up to the present day is characterised by recovery of some podocarp tree species (but not kauri) along with a range of small shrub and tree species, and with the decline and rapid disappearance of bracken. Earlier burn events at the time of the Kaharoa ash fall 665 BP +-15 (1285 AD) and another at 2223 BP +- 60 (273 BC) that may relate to the Taupo eruption, show short term charcoal peaks with no significant immediate impact either negatively or positively on the amount of rimu or kauri pollen present. Along with the very minor and short term appearance of bracken fern, this suggests that these were natural fire events and not of anthropogenic origin.

The fourth and fifth studies were made on the eastern coast of Aotea (Great Barrier Island). Located in the northern third of the offshore island zone, Aotea is by far the largest island in the study area and contains enough environmental variation to be considered a mainland in its own right. The fourth study was made at Awana Bay by Horrocks in 1999 and the fifth by Deng at Whangapoua Estuary in 2004 (Horrocks *et al,* 1999; Deng 2004). Both looked at reconstructing natural vegetation sequences of mixed podocarp-hardwood forests and coastal communities that then encountered large scale anthropogenic deforestation no later than 650 cal yr BP.

In this zone of temperate offshore islands the recent and comprehensive examination of the long pollen sequences from Mayor Island and Great Barrier has allowed these islands vegetation history to be reconstructed. Researchers identified both anthropogenic and natural fire events and hint at possible longer term environmental changes in the period prior to human arrival. In particular the development of Kauri forests suggests a drier or slightly cooler climate in the mid-Holocene between 6000 and 1000 years BP (Newnham and Lowe, 1991, McGlone, 1988). It is interesting that when compared to recent studies on islands with limited pollen survivability such as Moutohora Island, or to earlier and methodologically limited studies such as occurred on Hauturu, there is a consistent pattern of initial anthropogenic burning of podocarp forests early in prehistory and then regular and ongoing burning of first successional plant species. Since Polynesian crops are essentially invisible in the pollen and charcoal record, this pattern of anthropogenic actions may be used as a proxy to explain Māori horticulture. Clearance with fire of the pre-human vegetation creates land that is then gardened. Subsequent ongoing burning removes first successional plant species (disturbed ground species) that invade the gardens following harvesting and fallow periods.

4.2.2 Questions asked of the Palynology

Due to the specialist skills needed, the palynology on the Poor Knights was undertaken in partnership with specialists from Landcare Research led by Dr Janet Wilmshurst. The goal of the field work was to obtain palynological data from both Aorangi Island and Tawhiti Rahi Island – the two major islands in the Poor Knights group. Knowing that Aorangi had a long term resident pig population that arrived in the early historic period while Tawhiti Rahi had always been pig free, it was hoped that the successful recreation of vegetation histories from the pre-human past to the present day would allow the islands to be contrasted and compared. The objectives of the palynology would be to (i) identify changes in the charcoal and pollen record from a pre-human baseline, that might indicate Māori utilisation and later abandonment of each of the two islands, (ii) obtain Radiocarbon dates for key places in sediment cores where such vegetation changes occur, and (iii) compare the timing and extent of anthropogenic vegetation modifications for Aorangi and Tawhiti Rahi, to determine if the chronology of Māori settlement varied during prehistory, and after European arrival when pigs were only present on Aorangi Island.

4.2.2.1 Locations for Sediment Coring

To successfully recreate a vegetation history, a sediment core must be obtained from a location where seasonal pollen rain and associated macroscopic charcoal have regular and ongoing deposition, where erosion or other disturbance events do not remove or rework existing pollen deposits, and where conditions for pollen preservation are good.

Lake bed or peat bogs deposits are the preferred locations to obtain cores as they meet all three criteria by undergoing continuously build up of pollen, are not commonly disturbed and remain consistently wet in an anaerobic environment which limits pollen degradation (Jacobson & Bradshaw, 1981). The problem on the Poor Knights Islands is that the low rainfall and permeable nature of the soil and underlying bedrock act against the creation of regular surface water that might lead to the creation of permanent swamps and bogs. What both islands do have are seasonal streams in their primary catchment zones.

Although stream beds theoretically should concentrate pollen that is washed in from their wider catchment zone, they can also experience periodic inundations that rework or damage existing pollen deposits, while associated sequential wetting and drying events associated with such inundations can seriously degrade captured pollen. Leahy and Nicholls relocated one of two previously recorded small areas of raupō at the end of the seasonally flowing Puweto Stream that runs through the primary catchment on Aorangi Island (1964:100), while the author noted a flax grove and sediment catchment bowls in the middle and end of the permanent Charles Stream at the southern end of Tawhiti Rahi Island. It was hoped that the flax and raupō groves along with the sediment bowls might catch and filter pollen, inhibit inundation erosion processes and perhaps avoid major drying events that are likely to occur everywhere else on these moisture poor islands. The field work aim was to attempt six cores, three from Puweto Stream on Aorangi Island and three from Charles Stream on Tawhiti Rahi Island.

4.2.2.2 Aorangi Island

The topography of Aorangi Island is dominated by the large north facing and draining Puweto catchment. This sheltered environment was the main gardening cultivation area on the island in prehistory, and like gardens on Tawhiti Rahi, contained bordered stone heaps, rows, retaining walls and terraces as well as single stone alignments that divide the valley into a number of field boundary systems. A centrally located seasonal stream that may have been modified by Māori divides the valley into two parts (Lawlor, 1988:14). The current vegetation is similar to Tawhiti Rahi with a single continuous canopy of pohutukawa and a relatively open understorey of small plants. After landing on the island, the Puweto stream was relocated and investigated, but the stream bed was dry and the hoped for remnant wetland area of raupōreported in 1964 was no longer present. Instead coring was attempted at three places along the lower bed of the dry Puweto Stream (Figure 4.2), but no acceptable palynological material was recovered. As the Puweto Valley was the primary catchment on the island, the presence of dry soil here made it highly unlikely that other locales would retain and preserve sediments. Therefore it was decided to abandon Aorangi Island and move the coring fieldwork to Tawhiti Rahi Island.

4.2.2.3 Tawhiti Rahi Island

Since Aorangi Island had shown that acceptable pollen core material did not survive in dry conditions, locations containing higher moisture levels were chosen on Tawhiti Rahi. The focus of the palynological fieldwork therefore was in the southern lowlands of Tawhiti Rahi Island, broadly within the Charles Stream catchment. This catchment contains the only stream that can be considered to have year round moisture and should therefore have sediments that might contain a pollen sequence. A total of three locations (A, B & C) were chosen for coring. One on a natural terrace at the landing site (R06-29), and two along the line of the South (Charles) Stream (Figure 4.2 and 4.3).

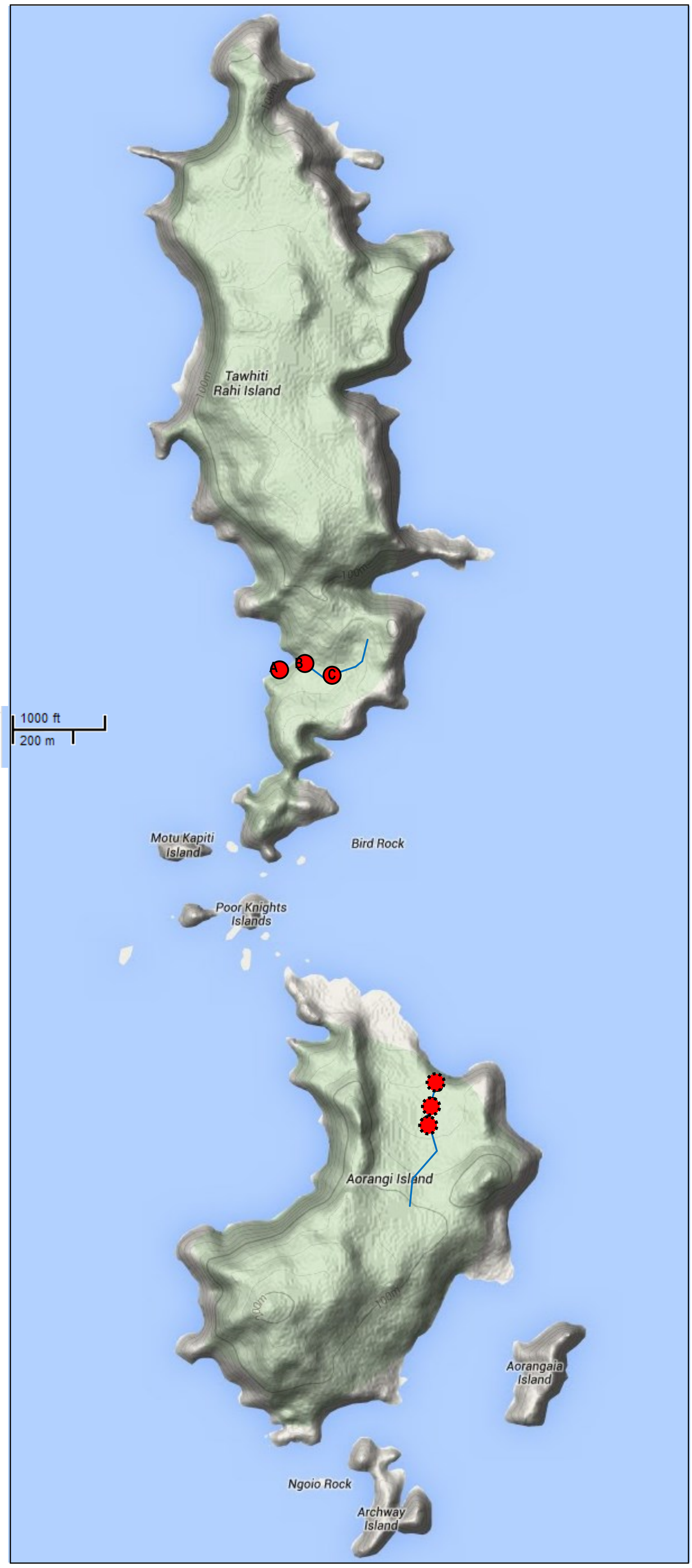

Figure 4.2 Three attempts at obtaining a pollen core along the Puweto Stream on Aorangi Island were unsuccessful [dashed red circles]. Three cores were successfully obtained from Tawhiti Rahi Island [solid red circles] at locations A, B & C. [Lat 27.988056, Long 86.925278: Google maps terrain shade model 27thMarch 2015]

Location of pollen cores A, B & C (Figure 4.3)

A: The Boat Landing Terrace.

The landing site (R06-29) is located on the south side of Landing Bay. Here a series of man-made and modified natural terraces descend the north facing slope and end above the only canoe landing location that can be used year around. The lowest terrace of this site is 5m above the high tide mark and contains a damp soil zone above a rock base that probing suggested was at least 40 cm deep and on which raupō and flax are currently growing. The presence of this deep soil profile and existing plants suggested that this terrace might be a natural rather than man-made formation that could have caught and possibly preserved pollen rain before, during and after human arrival on the island. Using a 'D' section hand corer, a 45 cm deep core consisting of organic soil was successfully collected.

B: The Lower Stream Bed.

The Charles Stream in the southern lowlands is the only permanently stream on Tawhiti Rahi. Due to the low rain fall and highly permeable nature of the soils and bedrock, it never experiences the volume of water commonly seen on Northland mainland streams, but it does have dramatic seasonal variations in flow. During weather events the line of modified ponds or bowls separated by constructed weirs and dams can flow with a large quantity of running water, while in dryer times no surface water is visible but the stream sediments remain at least damp from the subsurface seepage of moisture from regular dew and fogs. The stream should therefore collect and concentrate any pollen rain produced in this southern lowland catchment area and the permanent moisture in the ground should help preserve this pollen. Since running water in streams potentially erode and remove any caught pollen, specific locations in the stream that encourage deposition of pollen and inhibit erosion were chosen for coring.

The Charles Stream has been extensively modified with weirs, dams and river bed terraces and channels in its upper reaches. The lower third has had a series of bowls dug out of the main stream bed to create a series of descending ponds. The lowest and largest of these bowls is found just back from the cliff edge where the stream enters the bay in a minor waterfall. Measuring 3m wide by 5 m long, the pond is currently full of sediment. If as suspected, this was a man-made and not a natural feature, any sediment collected should reflect the human occupation phase of the island's history. Probing did not locate any clear base and so the 'D' section hand corer was used, and a 50 cm deep core of dark silt was successfully taken.

C: The flax grove in the upper stream bed.

Located in the central part of Charles Stream main channel above the main area of man-made

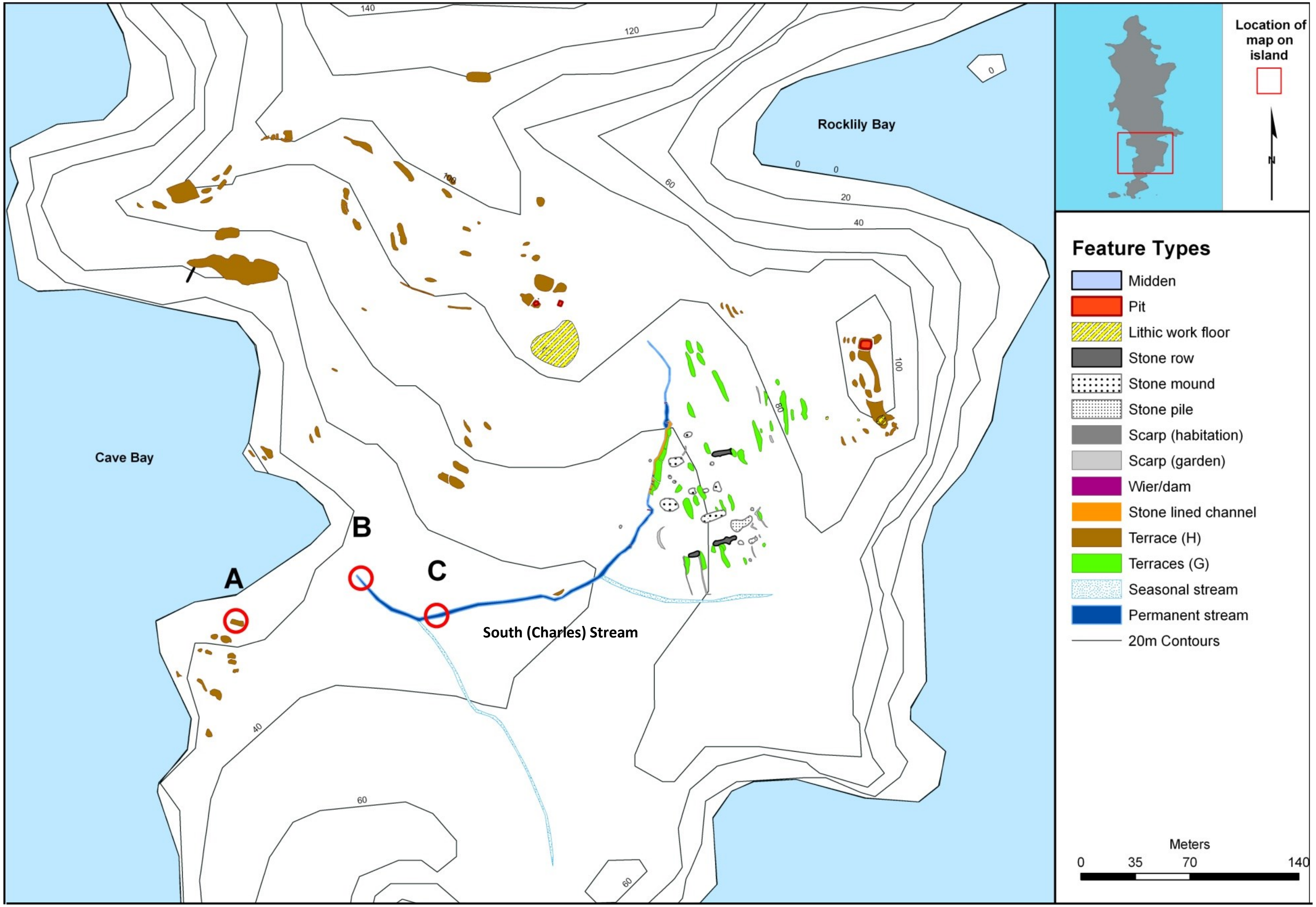

Figure 4.3 Three successful pollen coring sites on Tawhiti Rahi at the landing terrace (A), the Stream end (B)and flax grove (C).

bowls and below the area of weirs, dams, river bed terraces, is an area of gentle slope beneath a 4.5 m canopy of pohutukawa, with a dense understorey of flax and a diversity of smaller trees, shrubs and herbs (de Lange & Cameron, 1999). It was hoped that if flax predated human introduction, coring through it into the deposits below would show a longer environmental sequence that started before people arrived and extended through the whole human history of the island. Probing showed various depths of silt were present above a rock base, and so the 'D' section corer was used to take two adjacent and overlapping 50 cm cores (0-50 cm & 35-85 cm). In total 85 cm of consecutive peaty soil sediment was successfully collected.

4.2.3 Methods of Collection and Analysis

The collection of sediment cores was undertaken in 2008 by me and a specialist team from Landcare Research lead by Dr Janet Wilmshurst. The Department of Conservation provided the boat transport and some volunteers while Mr Rewi Hepi was the Ngatiwai representative. Three successful sediment samples (A, B & C) collected from Tawhiti Rahi were taken by Dr Wilmshurst back to Landcare Research for pollen extraction and analysis (Figure 4.3). An initial assessment suggested that cores A and B contained a high percentage of recent organic matter. To test their antiquity, bulk sediment samples were taken from the deepest parts of each core and sent to the Waikato Radiocarbon laboratory. The calibrated carbon dates obtained confirmed that the boat landing terrace core (A) had a date of 122+- 0.4% and the lower stream bed (B)a date of 111.4+-0.7%. Since both these dates are modern the sediments in them must post-date the island's abandonment, and so these cores were set aside. However the flax grove core (C) appeared to contain pollen, charcoal and tephra, with a low percentage of recent organic matter and so underwent detailed analysis. The analysis methods used have been published in a recent journal article (Wilmshurst *et al.*, 2014; subsequent information section).

Pollen: Along the 85 cm core, sediment was sub-sampled at intervals of 2 cm or 5 cm for pollen analysis, and at every 1 cm a similar sized sample was taken for organic content and charcoal analyses. Standard procedures were followed for preparation of microscope slides to be used for pollen analyses (Moore *et al.*, 1991; Wilmshurst et al 2014 Supporting Information). For each microscope slide, pollen from terrestrial plants was counted until a 'pollen sum' of 250 grains was achieved. When low pollen concentrations were encountered on a slide then all pollen grains were counted. Taxonomic groups of pollen used on the pollen diagrams included families, genera and species and followed Moar *et al.*, (2011). The identification of initial human activity in the pollen profile uses the appearance of distinct, unprecedented vegetation changes as a proxy (McGlone & Wilmshurst, 1999). Specifically this is represented by an associated cluster of changes that includes (i) an increase of charcoal, and (ii) an increase in key seral taxa (particularly bracken spores and grass pollen *(Poaceae)* and (iii) a concomitant decline in pollen and spores from forest taxa.

Charcoal: Using standard charcoal-analysis procedures samples collected every 1 cm along the core were used to reconstruct the island's fire history (Whitlock et al, 2001). Using nested sieves of 125 and 250micron mesh size, all charcoal particles present in a 1 ml sample were counted to produce the two sizes of macroscopic charcoal data collected. In a parallel process, the point-count technique was used to record microscopic charcoal particles on the pollen slides (Clark, 1982). Specifically a count was made of charcoal particles that intersected any of the 11 points on a graticule seen in all the fields of view during the pollen count, and this was expressed as a percentage of the pollen sum. The organic content of each 1 cm soil sample used standard techniques to measure organic content (Bengtsson & Enell, 1986) & is recorded as loss of sample weight as a percentage of original dry weight (Wilmshurst et al, 2014 Supporting Information).

Tephra: Lighter bands of material thought to be tephra were noted at two depths. Near the base of the core a lighter colour was noted in the sediment at 80-83 cm while at 39-56 cm there was a wider band of lighter coloured material. While the tephra at the base of the core was not assessed, an electron microprobe was used to analyze the chemistry of glass shards from the upper band of more recent tephra to identify the eruption source.

4.2.4 Discussion of the Published Results

Following a discussion on the accuracy of the dating, the results of the pollen study are described in two sections. The first section (4.2.4.1) looks at the reconstructed vegetation history along with the associated charcoal and organic content data. This produces an undifferentiated 1:1 three phase stratigraphic model of vegetation change based on sequential analysis of sub-samples from the flax core. The second section (4.2.4.2) adapts this to create a summary of anthropogenic vegetation changes relevant to archaeologists through the use of 'forest' and 'disturbed' categories and the creation of a Bayesian age depth model with a variable stratigraphic model that can take into account variable rates of pollen deposition and includes independently dated historic events and tephra events.

Dating: For pollen analysis the most accurate dates are obtained from pollen concentrates as they are least likely to have in-built age issues. Therefore four pollen concentrate samples were chosen from points of vegetation change in the flax stream core at 40, 53, 70 and 82cm and these were submitted to the Rafter Laboratory in Wellington for accelerator mass spectrometry (AMS) dating. The results obtained were all anomalous, with some being inverted due to laboratory contamination, and all others giving significantly older dates that were not consistent with the independently dated Kaharoa tephra. As an alternative peat samples from the core were submitted to the Waikato Radiocarbon laboratory for AMS radiocarbon dating. It is accepted that peat is not an ideal dating mediumsince itcontains unidentified charcoal that has a non-quantifiable chance of being contaminated with older or younger charcoal. To minimise the impact of older/younger charcoal in any given sample, two approaches were used. First, a total of nine samples (seven soily peat; two bulk peat) were taken between 40 and 83 cm in the core. These included and bracketed the sample collection depths that were sent for pollen concentrate analysis and, if not contaminated, should provide a descending sequence of dates. Secondly, only 5 mm thick sections were taken for each sample so as to limit any inbuilt age issues associated with deposition. From the calibrated results two separate Bayesian age/depth models were created. The published version was constructed using stochastic linear interpolations between calibrated radiocarbon dates (Wilmshurst et al, 2014; Supporting information Appendix S3). The second unpublished version used here incorporated additional age constraints identified in the historical literature as well as calibrated radiocarbon dates (this thesis Appendix 8i).

Looked at in isolation from the pollen data, there is a general agreement on dates that shows that seven of the nine samples appear accurate with the other two reflecting in-built age from old charcoal (Appendix 8i, Figure 1). Unmodelled date ranges to two sigma (95 %) taken from bulk sediments where two of the nine have been contaminated with old carbon, can only state that human use of the island spans the full c. 650 years human settlement in New Zealand, starting 'early' and finishing 'late'. However when looked at with regard to the stratigraphic presence of fundamental changes in pollen from pre-human forest to human burn gardens, the independently dated Kaharoa tephra, and the presence of significant pine pollen, it is argued that the dates are broadly correct with the possibility of some being locally incorrect due to mixing during erosion events (discussed in Appendix 8i). The date range obtained from peat samples in this core is broadly consistent with the timing of New Zealand's prehistory. A final determination on acceptable tight age bands would however require further palynology, with this flax area being cored for a second time, and to use pollen concentrates for AMS dates.

4.2.4.1 Reconstructed Vegetation History

The analysis of the flax stream core was published in 2014 by Wilmshurst with myself as one of six other co-aurthors (Wilmshurst *et al.,*2014). Figure 4.4 shows the pollen record for podocarp and angiosperm tall trees along with data from sieved macroscopic charcoal (both 125 and 250micron), microscopic charcoal and organic content (loss on ignition). Specific pollen diagrams for small trees and shrubs, herbaceous taxa, and ferns and bryophytes are shown in Figures 4.5 to 4.7 below. All pollen diagrams 4.4- 4.7 are divided horizontally into three sequential zones of

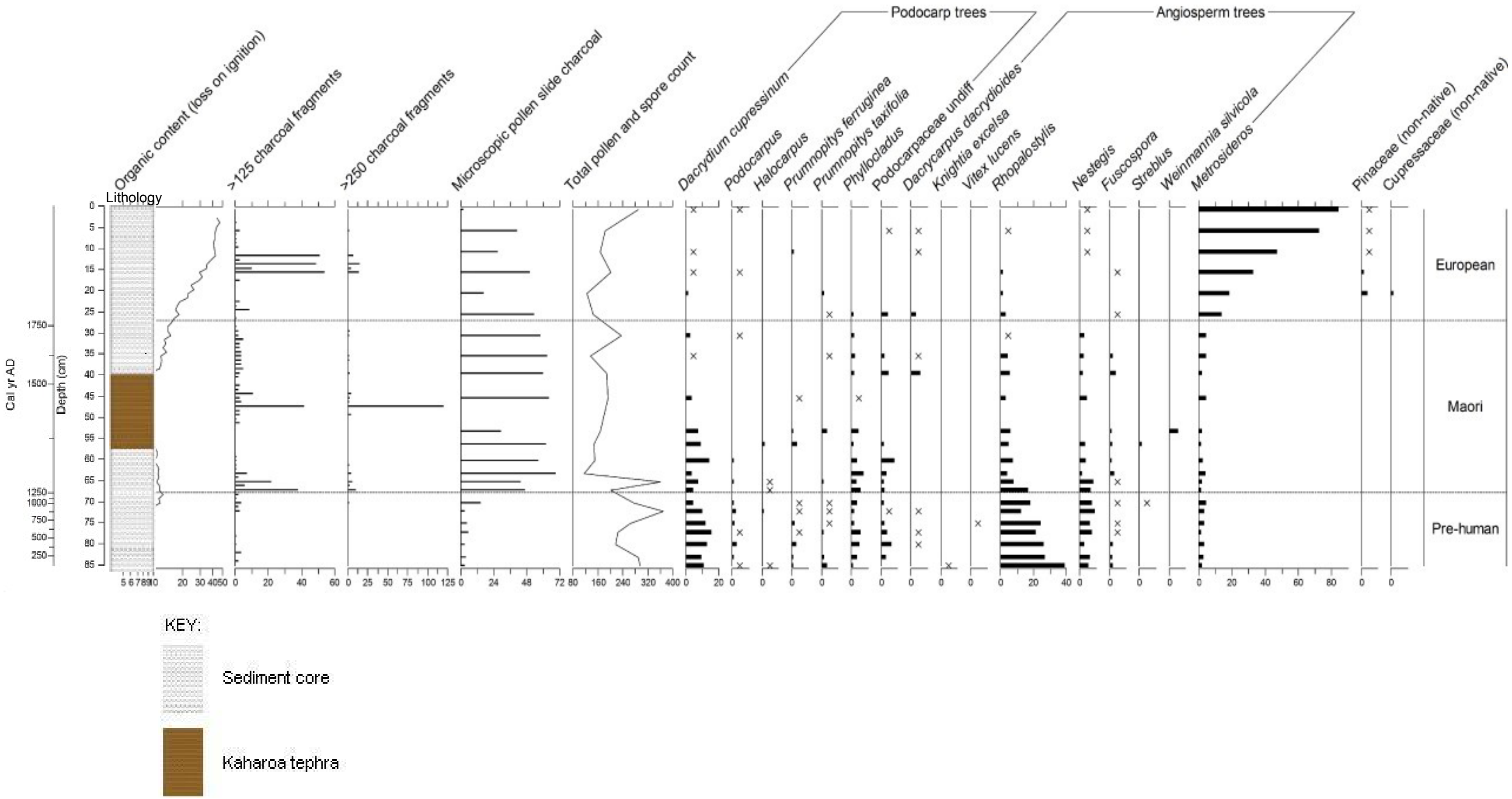

Figure 4.4 Flax grove C soil core: Organic content of soil (percent loss of original dry weight), microscopic charcoal counts (number of fragments <125 micron), macroscopic charcoal counts (number of fragments >250 micron), microscopic charcoal on microscope slide of pollen (percentage of total pollen and spores), total number of pollen grains and spores, and pollen percentage values found for tall tree taxa (×, taxa recorded below 1%). (Wilmshurst et al, 2014: Figure 1). [Lithology added 2015].

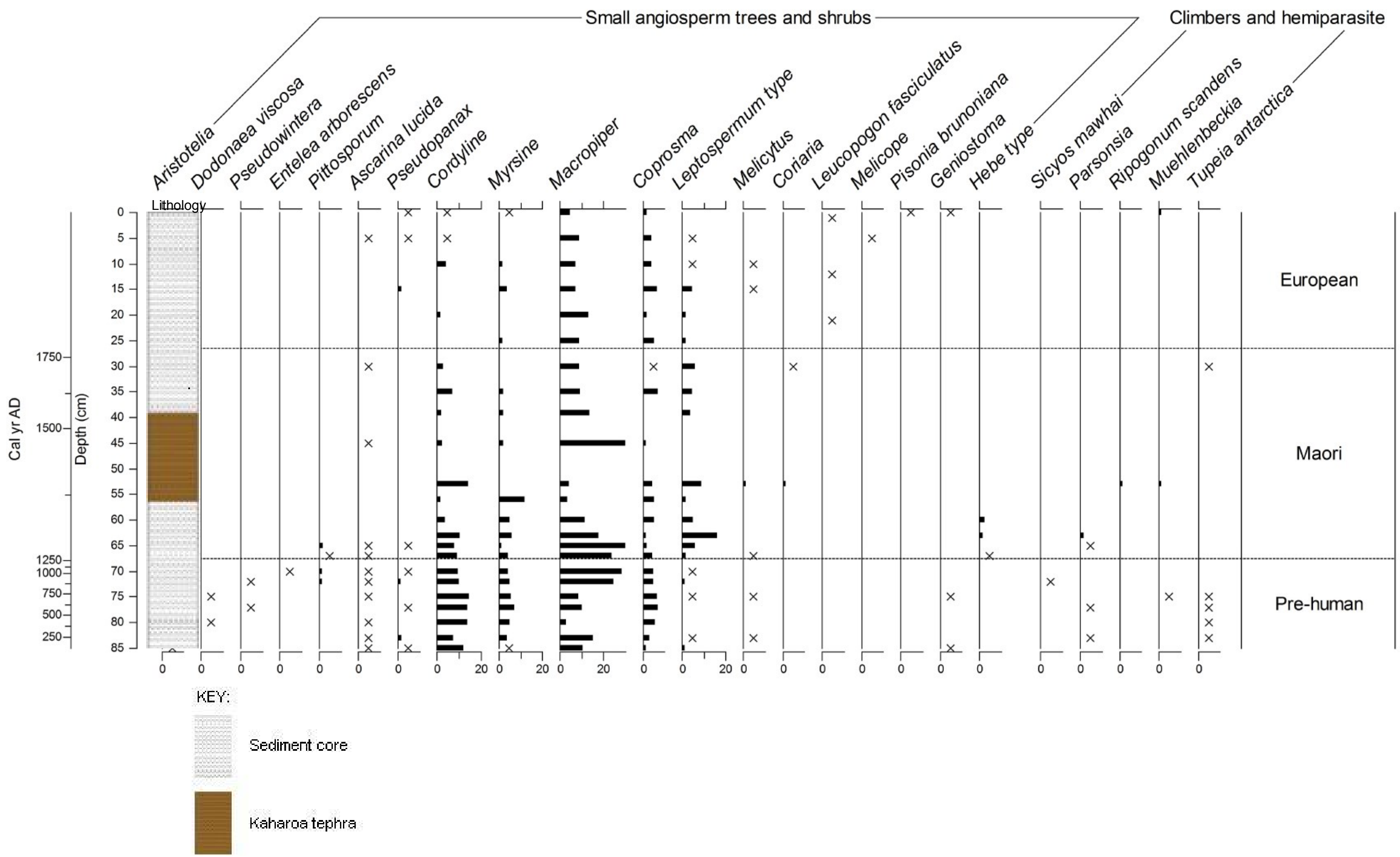

Figure 4.5 Flax grove C soil core: Percentage of pollen found for small trees, shrubs, climbers, and hemi parasites at Tawhiti Rahi (×, taxa recorded below 1%). (Wilmshurst et al, 2014: Figure 2). [Lithology added 2015].

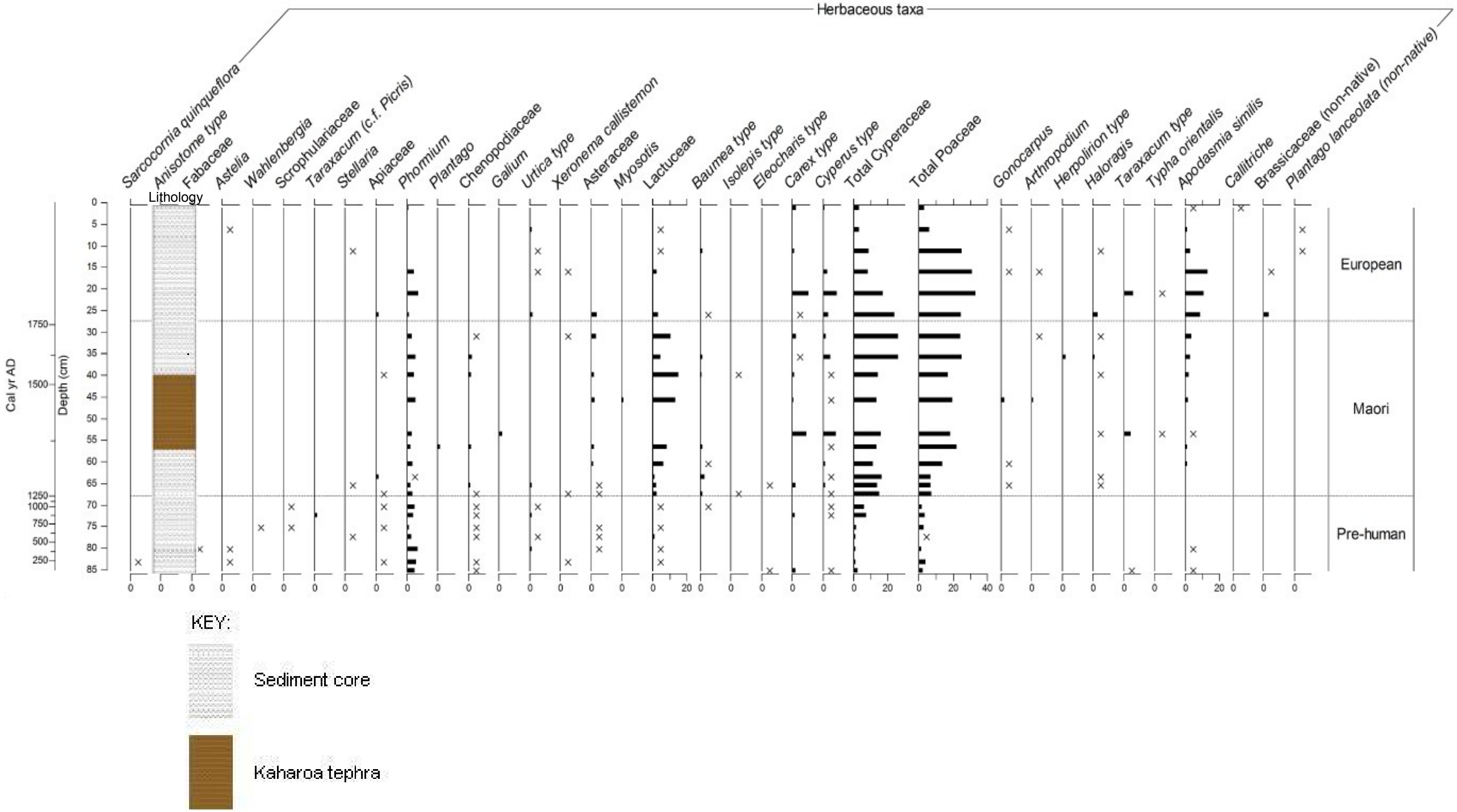

Figure 4.6 Flax grove C soil core: Percentage of pollen found for herbaceous taxa at Tawhiti Rahi (×, taxa recorded below 1%). (Wilmshurst et al, 2014: Figure 3). [Lithology added 2015].

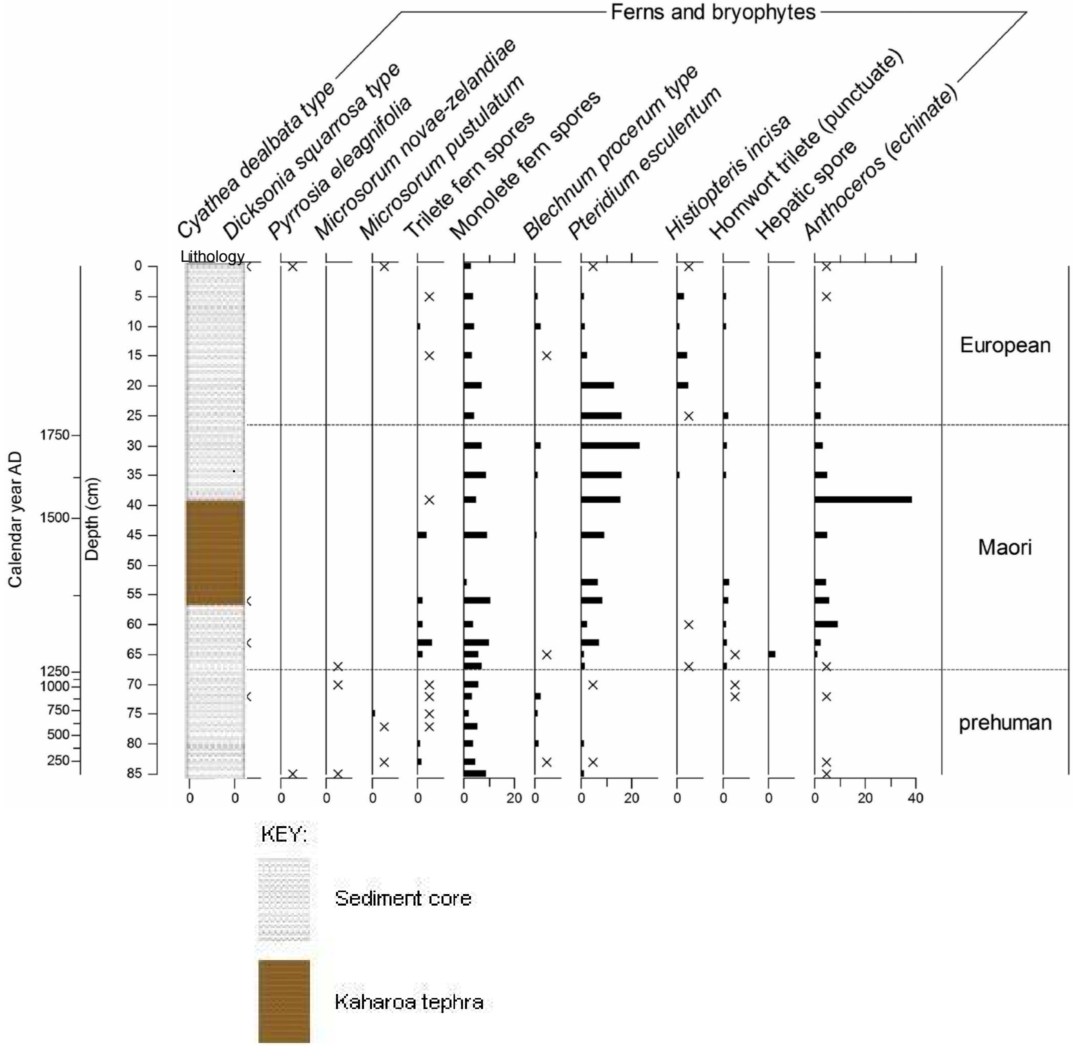

Figure 4.7 Flax grove C soil core: Percentage of spores found for tree ferns, ground ferns, epiphytic ferns, and bryophytes at Tawhiti Rahi (×,taxa recorded below 1%). (Wilmshurst et al, 2014: Figure 4). [Lithology added 2015].

statistically distinct vegetation compositions using the Bray–Curtis index to quantify compositional dissimilarity between zones (Oksanen et al., 2012). Phase 1 predates human arrival, at 85–67 cm, Phase 2 representing Māori occupation, at 67–28 cm, while Phase 3 represents the European period, at 28–0cm.

Phase 1. Pre-human phase (c. AD 230 to AD 1280; 85–67 cm): The pre-human phase in all four pollen diagrams is characterised by a predominantly podocarp forest canopy with tall trees such as rimu being the most common, with 10–15% out of a total podocarp pollen record of 13-30%. Angiosperm trees present in this canopy include the monocotyledonous cabbage tree and black maire (*Nestegis sp.*) and especially the palm (*Rhopalostylis sp.* -probably *R. sapida*). Known by Māori as 'nikau' this tree is rarely found in pollen cores, and its presence at up to 40% of the total pollen count suggests localized dominance with the only other known parallel being the interior of Hauturu (Little Barrier) Island and in Taranga (Hen) Island where it is found in a non-podocarp forest (Wilmshurst pers comm. 2015). The understorey of small trees and shrubs contains primarily angiosperms dominated by *Piper sp.* , *Coprosma* spp., and *Myrsine* spp., with lesser amounts of *Phormium sp.*, Poaceae, and ground and epiphytic ferns (represented by nondescript monolete spores) (Wilmshurst et al, 2014: 205). A 5 mm bulk peaty soil sample taken from 83 cm was radiocarbon dated [sample Wk-26020] and this gave a 95% range of 70-240 AD and a median date of 162 AD. Tephra glass sherds were observed as a colour change in the sediment at 80-83 cm at the base of the core. These were not identified by micro-probe analysis as there was insufficient sample material to analyse. However their presence at this depth is consistent with the Taupo eruption in that ash fall from Taupo has a comparable date (183 AD) and is known to have reached similar latitudes in Northland at Pataua (Pullar et al, 1977:705).

Further indirect support for these sherds being from the Taupo eruption comes from a decrease in organic content to 10-20% in the soil at 81-83 cm where the tephra was identified. This mirrors a similar decrease in organic content to 10% at the time Kaharoa tephra appears in the core at 39-56 cm (see Phase 2). The presence of small charcoal (microscopic &>125 micron) but no changes in taxa at 82cm suggests that, while no local fires can be associated with this eruption, wind-transported material from distant fires associated with the Taupo eruption center 400 km to the south, might have reached this island (Wilmshurst & McGlone, 1996).

Phase 2. Māori Gardening Phase (c. AD 1280–1823; 67–28 cm): Compared to the phases above and below it, the Māori gardening phase has poor pollen preservation and concentrations, attributable to the low organic content (<10%) of the soil (Figure 4). Compared to the previous pre-human phase, over 50% of the tall forest taxa present disappear entirely, and the species remaining are represented by drastically reduced pollen counts with the exception of pohutukawa, which remains fairly constant. Running parallel to this decline is a significant increase in the appearance of both macroscopic and microscopic charcoal particles along with pollen from seral taxa, notably bracken fern and grasses. This rapid conversion of forest to open areas is considered to represent the arrival of Māori settlers on the island and their clearing of the forest with fire to establish gardens. Since direct evidence of cultigens grown by Māori are not easily identifiable from pollen cores, due either to low pollen production or to being harvested prior to flowering and pollen production, then these changes in the natural vegetation record are considered to be an indirect proxy for human presence.

The tephra present in the middle of this core (shown in Figs. 4.4 – 4.8) has been identified as originating in the Kaharoa eruption (Wilmshurst et al, 2014: Supporting information). This represents New Zealand's only rhyolitic eruption since 1000 AD, and the Poor Knights Islands lie just inside the northern extent of its 3 cm isopatch plume of ash. Kaharoa ash is known to have been erupted in a single event (Lowe *et al.,*1998*;* Nairn *et al.,* 2001: Figure 1 inset p488), so the first presence of this tephra at 56 cm in the flax core is therefore deemed to coincide with the independently determined eruption date of 1314 AD [+-12ys] (Hogg et al.,2002: 121). The presence of Kaharoa ash in a broad band between 56 and 39 cm in the core most likely reflects over-thickening at the site from later re-deposition from the surrounding landscape catchment during high rainfall events. The first appearance of the tephra at 56 cm is taken as representing the eruption date of 1314 AD (+-12ys). A radiocarbon date from bulk charcoal sample Wk-26755 was taken from 67 cm - below this tephra - at the interface of phases 2 and 3. This yielded a calibrated age range (2 sigma) of 1280–1400 AD. Knowing the date of the Kaharoa eruption, the base of this tephra at 56 cm provides an upper boundary to the calendar date range of sample Wk-26755, reducing it to AD 1283–1314. This is consistent with New Zealand's earliest phase of colonisation (Wilmshurst et al.,2008).

Finally, the fall of this ash is considered to not have had a significant impact on the vegetation. This is because the dated sample WK26755 shows anthropogenic forest clearance in this period had already highly modified the island's vegetation by the time the eruption occurred, and so the effects of the Kaharoa tephra on Tawhiti Rahi would have been negligible, especially since the Poor Knights Islands are 350 km away from the eruption centre. This is supported by pollen records from Waihi Beach, where similar human modified vegetation shows no vegetation disturbance associated with the 4 cm isopatch of Kaharoa ash that fell from the eruption centre located only 50 km to the south (Newnham et al., 1998).

Phase 3. European Phase (c. AD 1823 to present; 28–0 cm): The European phase marked the end of Māori gardening and permanent human habitation in AD 1823, and the start of natural reforestation on the island. This phase had the lowest number of forest taxa represented, except for pohutukawa (*Metrosideros robusta* type representing *M. excelsa* on this island), which increased steadily to reach 86% and dominate the vegetation at the top of the phase. Pollen and spores of light-demanding taxa (e.g., *Leptospermum* type (includes *L. scoparium* and *Kunzea ericoides*), sedges, grasses, rushes, lactuceae, bracken, and hornworts declined as the pohutukawa developed into a tall closed-canopy forest. Non-native species appeared for the first time, including introduced grasses (*Poaceae*), the agricultural weed *Plantago lanceolata*and a variety of conifer trees (*Pinaceae*). Such conifer taxa have never grown on the Poor Knights Islands but their pollen is transported long distance by wind, and its presence likely reflects the establishment of plantations on the adjacent mainland from at least the 1930s (Thode, 1983). Large charcoal particles were absent from the base of the phase, indicating a period without fires. However, several peaks of charcoal particles between 11 and 15 cm may reflect two historic fires documented in 1923 and 1958 (Appendix 6). The fire damage isvisible in aerial photos taken in 1960 that show a large area immediately south of Charles Stream with only low vegetation (New Zealand Aerial Mapping vertical photograph run SN1314, shot A3). The timing of these documented historic fires is consistent with the age-depth model for the core discussed in the following section. The accumulating litter of the developing pohutukawa forest north of Charles Stream was not fire damaged and this explains the organic content of the soil increasing from 15% at the base of the phase to 44% at the top of the phase. In this European period, the regenerating native species are dominated by the pohutukawa, an angiosperm tree. The pollen composition of this European period bear little resemblance to the pollen composition of the pre-human phase and this is confirmed by the mean of all Bray–Curtis dissimilarity index distances of 0.74 (SD 0.04), where 0 is complete overlap and 1 is no overlap (Wilmshurst et al, 2014: 206).

4.2.4.2 Anthropogenic Vegetation Change

This doctoral research is focused on understanding the timing and nature of human use of the island. It uses the flax stream pollen core data to examine in detail the changes recorded in the pollen and charcoal record and discusses what they can tell us in regard to 'when and 'why' this island was settled. Focusing on the 'when' question first the unmodelled dates obtained from bulk sediments are shown (Table 4.1) and an independent Bayesian age/depth model created by Dr Peter Dillingham is presented (Table 4.2). This model provides a variable stratigraphic model that provides improved modelled calendar accuracy when compared to the Wilmshurst stochastic model, by proposing variable rates of pollen deposition and including independently dated historic accounts and confirmed tephra events. The criteria underpinning this model and a detailed exposition of the results of this analysis are set out pictorially and in text in Appendix 8i.

To address the 'why' and 'when' questions a new pollen diagram (Figure 4.8) was created summarising the pollen data (Wilmshurst et al, 2014; Figs. 1-4). Existing column data associated with pollen has been summarised and simplified and now only includes pollen that falls within the two descriptive groups of 'Forest species' (that relates to vegetation patterns both before and after human occupation) and 'Disturbed species' (relating to vegetation patterns during human occupation). New data in the summary pollen diagram are found in two additional columns. One provided by Wilmshurst shows the total number of taxa recorded, while the other shows the modelled age/depth calendar dates produced from the Dillingham Bayesian analysis (discussed above).Existing row data has now been modified with a division of 'Māorigardening' into early Māori and late Māori, while a new row data titled 'Kaharoa ash' now overlays the two Māori periods. Within a context of 'presence' and 'absence' scenarios, individual factors in this summary model are now analysed to show how they can assist our understanding of the timing (the 'when' question) and nature (the 'why' question) of anthropogenic processes that occurred on Tawhiti Rahi Island. This is discussed under the headings of 'Forest species', 'Disturbed species', 'Charcoal' and 'Tephra'.

Forest species: Forest species dominate the island vegetation before human arrival. In this pre-human phase there are eleven forest species present, four with high pollen counts (nikau, rimu, cabbage tree, and kawakawa), four with medium counts (*Coprosma, Myrsine*, maire and tanekaha), and three with minor pollen counts (totara, miro and pohutukawa). Pollen counts for these eleven fluctuate but do not significantly change until the early Māori period. The early Māori period saw eight of the eleven species fluctuate and significantly decline, to either disappear or become very minor pollen generators by the end of the late Māori period. Three of the eleven fluctuated but did not significantly decline or rise (*Coprosma*, kawakawa and pohutukawa). It is only after people abandoned the island in the final European phase that pohutukawa significantly increased to dominate the pollen assemblage. The fact that pollen counts for pohutukawa continued to climb and follow a rising partial bell curve during this period despite historic fire events completely removing the pohutukawa canopy south of the Charles Stream, strongly suggests that the catchment for pohutukawa pollen was not limited to the southern part of the island but was instead island wide. As would be expected of shade tolerant species, kawakawa and *Coprosma* appear unaffected by the appearance of this tree canopy, butall the other tree species that required direct sunlight declined as the pohutukawa increasingly shaded them out. It is the

Table 4.1 Calibrated radiocarbon dates using accelerator mass spectronomy (AMS) on soily peat and bulk peat soils from the flax grove core, Tawhiti Rahi Island [Appendix 8i;Table 1].

Depth (cm)	14C code (Waikato Wk No.)	14C age (BP: Years before 1950) [a]	14C (standard error of measurement)	Material dated	13C	Age (AD: 95% range)	Notable historical events
40	23857	505	30	Soily peat	-25.2	1400-1470	
52	26884	601	30	Soily peat	-24.8	1310-1430	
53	23858	665	30	Soily peat	-25.2	1290-1400	
56						?	Kaharoa tephra appears - 1314 AD
58	26885	* 512	30	Soily peat	-25.1	*1400-1460	
66						?	Earliest Māori arrival after 1280 AD
66	26754	*1079	30	Soily peat	n.d[b]	* 900-1130	
67	26755	702	30	Soily peat	n.d[b]	1280-1400	
69	23859	974	30	Soily peat	-25.3	1030-1180	
70	26019	1116	30	Bulk peat	-26.1	890-1030	
83	26020	1911	30	Bulk peat	-27.3	60- 230	

All radiocarbon dating done by the Waikato Radiocarbon Laboratory, New Zealand.
Calibrated by OxCal .v4 2.4 Bronk Ramsey (2013); r: 5; SHCal13 atmospheric curve (Hogg et al, 2013)
[a] Reporting of radiocarbon ages follows (Stuiver & Polach, 1977).
[b] Sample too small to measure ^{13}C.
* Inconsistent with other dates. Not used in this model

Table 4.2 Comparison age-depth models for the flax grove core. Modelled dates from Dillingham [Appendix 8i; Table 2], and Wilmshurst [Wilmshurst et al., 2014, Supporting information].

Depth (cm)	Source	Calibrated 95% range AD	Calibrated Median AD	Dillingham Modelled Median -AD	Dillingham Modelled 95% range AD	Wilmshurst Modelled Median -AD	Wilmshurst Modelled 95%rangeAD
0	Modern	-		2006	2006-2006	2002	1998-2002
20	Pine pollen	-		1870	1830-1930	1859	1832-1943
28	Abandonment	-		1810	1790-1823	1759	1600-1806
39	Kaharoa top	-		1450	1410-1490	1515	1490-1659
40	Wk23857	1400-1470	1440	1440	1400-1480	1496	1475-1549
52	Wk26884	1310-1430	1400	1350	1320-1410	1445	1420-1469
53	Wk23858	1290-1400	1350	1340	1310-1400	1402	1368-1438
56	Kaharoa base	-		1314	1300-1360	1386	1354-1421
58	Wk26885	* 1400-1460	1440		na		na
66	Early Māori	-		1310	1240-1360	1310	1240-1360
66	Wk26754	* 900-1130	1010		na		na
67	Wk26755	1280-1400	1350	1290	1220-1330	1334	1289-1367
69	Wk23859	1030-1180	1100	1090	1020-1180	1123	1054-1202
70	Wk26019	890-1030	980	1000	900-1030	1023	897-1074
83	Wk26020	60- 230	150	160	70-240	236	134- 361

* Inconsistent with other dates. Not used in this model

appearance of a continuous pohutukawa canopy over the whole island sometime after the 1940s that explains the final disappearance of all other tree species apart from kawakawa and *Coprosma* in the top 5 cm of the pollen record.

Disturbed plant species: These succession species are light dependant and are listed in this summary diagram as five groups that cluster as either very fast growing (sedges, grasses and bracken) or moderately fast growing (liverworts and kanuka species) that grow in areas of disturbed soil. Prior to human arrival these species are only minimally represented, but during the early Māori period all five groups dramaticallyincrease in number due to the start of anthropogenic burning. This high representation continues throughout the late Māori period, and well into the European period, reflects ongoing Māori burning and then historic fires after the island was abandoned. The rise of pohutukawa after human departure is mirrored by a parallel decline in the pollen count of disturbed species, so that by the end of the pollen sequence, kanuka has disappeared and the other four disturbed plant species are present only in very low pollen counts. Ignoring minor fluctuations in the pollen record, there is an interesting profile parallel between sedges and bracken fern, with both showing a spike in pollen production following initial burning and then a long constant presence during the early Māori period. This does not seem to be affected by the arrival of the Kaharoa tephra plume. Only in the late Māori phase do pollen counts for sedges and bracken significantly increase again just prior to their final decline in the European phase, when they are shaded out by pohutukawa.

Charcoal: The appearance of significant quantities of microscopic and macroscopic charcoal in the vegetation record after human arrival, and its continued and ongoing presence through the early and late Māori period and into the European period suggests that anthropogenic burning occurred regularly and frequently. The wide dispersal of airborne microscopic charcoal cannot be limited to fire events specific to this island, but its initial and ongoing appearance from 1290 AD is consistent with anthropogenic fires associated with general Polynesian arrival into New Zealand (McGlone & Wilmshurs,t 1999). However because of its size, the macroscopic charcoal particles recorded in both the 125micron and 250micron columns must have originated from local fires on Tawhiti Rahi Island (Whitlock & Larson, 2001). Since the core was taken in the southern lowlands located at least 400m away from the plateau, the macroscopic charcoal recovered must reflect fires localised to the southern quarter of this island.

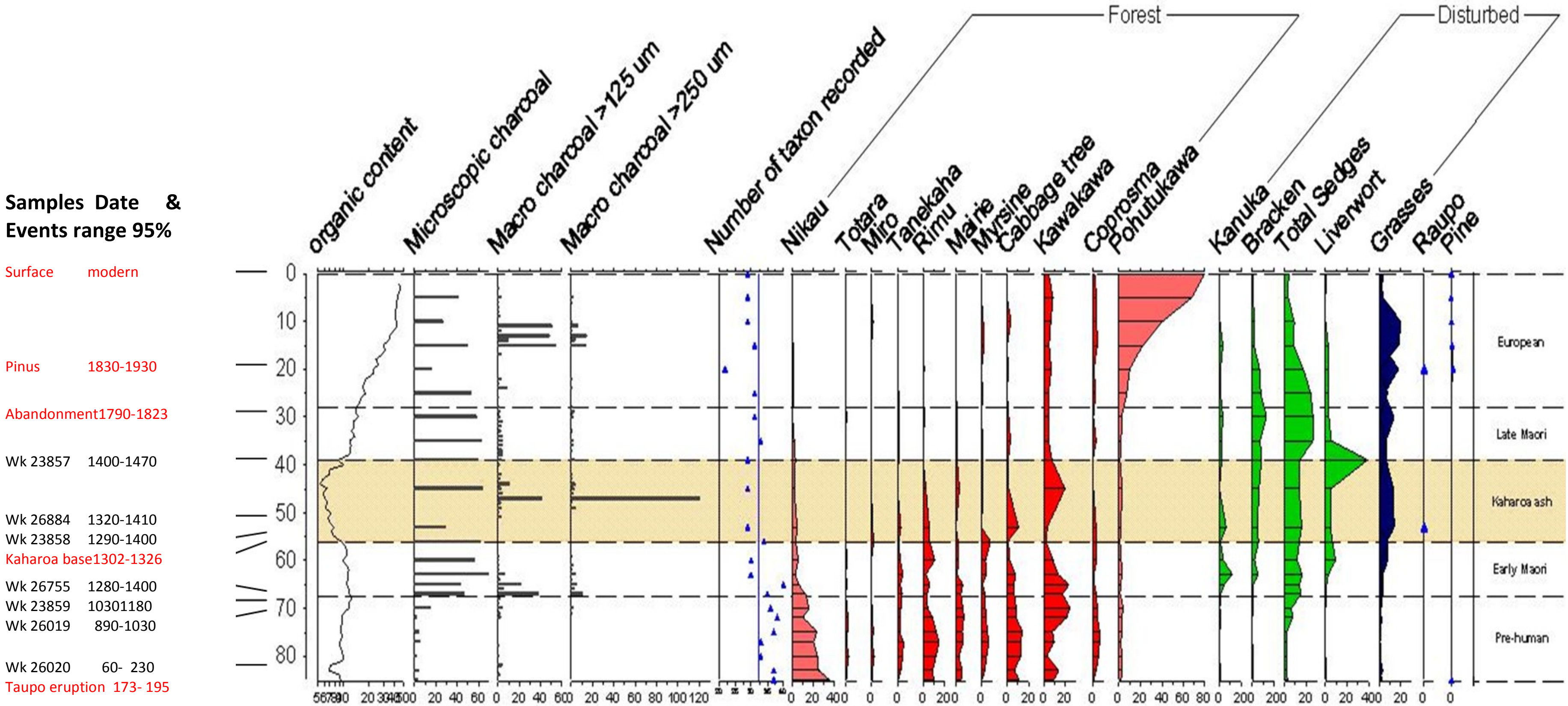

Figure 4.8 Flax grove C soil core: This summary pollen recordsimplifies and divides the published pollen data into two categories , 'Forest' and 'disturbed', and displays these on the horizontal axis [J Wilmshurst, 2012]. An age/depth model has been added to the left on the vertical axis. This shows estimated calendar date ranges to 95% (i) directly from radiocarbon determinations using calibrated data (black), and (ii) indirectly from a Bayesian analysis of historic data and independently dated tephra [P Dillingham 2010; in Appendix 8i]

Both macrocharcoal columns show the same three peaks. The first peak at 1290 AD is also paralleled by the appearance of significant microscopic charcoal and is interpreted as the initial anthropogenic fire event following human arrival. Coinciding with the Kaharoa eruption there is a gap in both macroscopic records and a reduction in the microscopic record sometime in the latter part of the 30-40 year period between 1314 AD and 1350 AD. Between 1350 AD and 1823 AD there is ongoing presence of 125micron macroscopic charcoal and this includes a spike that appears in both macroscopic charcoal records sometime after 1350 AD and before 1440 AD. This 475 year period of increased charcoal presence between 1350 and 1823 AD is interpreted as a time of ongoing and regular Māori burning activities associated with horticulture. The European phase is characterised by the end of regular and ongoing burning as represented in the macroscopic charcoal (>125 micron) column. A single wide charcoal peak visible between 11-15 cm in the both macro charcoal columns may reflect the two historically recorded fire events on Tawhiti Rahi in 1923 and 1957 merging as they wash in gradually (Appendix 6).

If minor fluctuations in the pollen record are taken into account there is an interesting profile associated with a short gap in the macroscopic charcoal sequence between 52 and 60 cm that occurs soon after the initial anthropogenic burn event. Here, in the disturbed species group at least two species (kanuka and bracken fern) have an initial spike in pollen and spores at the time of the fire, followed by a sharp decline then recovery to a constant level in pollen production. The forest group has an inversion of this with at least three species (rimu, *Myrsine* and cabbage tree) that have an initial decline in pollen at the time of the fire followed by a sharp upward spike in pollen production that then declines again after burning becomes endemic. Together these changes in the pollen record around the time of the Kaharoa eruption appear consistent with the gap in the macroscopic charcoal record reflecting a temporary halt to anthropogenic burning.

Tephra: Kaharoa and (probably) Taupo eruptions are present in the summary model at age appropriate depths of 83 cm and 39-56 cm respectively. The Taupo shards occur only in a narrow band containing limited amounts of microscopic material that is only visible under magnification. Kaharoa shards occur in a wide visible band of macroscopic and microscopic material that has also undergone erosion and reworking processes associated with Māori gardening practices. Neither tephra appears to have a clear one-to-one relationship with other changes observed in this summary model. For example both tephra are associated with a general reduction in organic content, but they differ in that Taupo experiences only a short term reduction while Kaharoa has a decline in organic content that takes much longer to recover. When compared with the charcoal record, neither eruption event appears directly associated with any significant fire events on the island since there is no observable charcoal spike at the time of the Taupo eruption while the much higher level of microscopic and macroscopic charcoal present at the time of the Kaharoa eruption (56 cm) began some time earlier since it starts 21 cm deeper and then continued for many hundreds of years afterwards. Compared to pollen amounts and species present in both forest and disturbed categories, the Taupo eruption event had no obvious effect while changes shortly after the Kaharoa event are probably the result of delayed effects that are better explained by anthropogenic processes.

4.2.5 Discussion of Research Results

The historical, biological and geographical constraints present on Tawhiti Rahi Island enable us to have more confidence to interpret the results of palynology in ways that are clearer and sometimes broader than can be done on larger landmasses. In particular it allows us to engage with the themes of island centric environmental change and to distinguish between natural and anthropogenic causes in time periods before, during and after human occupation. This requires an understanding of an islands natural ecosystem prior to human arrival and the subsequent processes of anthropic and natural environmental change that occurred following human colonisation. The detailed examination of the charcoal and pollen records were used to indirectly address questions about the length of human occupation and the nature of this human settlement on Tawhiti Rahi. Like many offshore islands the environment of the Poor Knights Islands is not conducive to the coring of pollen due to low rainfall and lack of standing water limit where pollen could be preserved. Out of the six attempts to find preserved pollen deposits on the two major islands in this group we were successful only once at the Flax core site located in Charles Stream on Tawhiti Rahi Island. Even here there were major problems of pollen preservation due to repeated wetting and drying events that resulted in damaged pollen that was difficult to identify.

Lacking pollen from both islands, we were unable to compare and contrast the vegetation histories of the two main islands of Aorangi and Tawhiti Rahi. However the one successful core did produce a 1900 year pollen and charcoal sequence that enabled us to reconstruct the vegetation history of the whole island and the fire history of the southern lowlands of Tawhiti Rahi Island. In this sediment core, key changes in the presence or absence of forest species, disturbed soil species, macro charcoal and tephra were identified and will now be discussed.

4.2.5.1 Forest Species

Forest species had minor changes in pre-human times that may be the result of natural variability. During the early and late Māori phase all tree species declined or remained at low levels, consistent with anthropogenic burning reflected in the three charcoal particle size records. Following the departure of people from this island environment it was pohutukawa that became the first plant species to dominate the island. The key change during the pre-human, human and post-human periods is the number of taxa recorded around Tawhiti Rahi. This ranged from 35-45 taxadominated by a podocarp broadleaf nakau forest before human arrival and immediately dropping by 25% to a constant 25-35 taxa, dominated by grassland species, after human arrival. After human departure taxa numbers do not increase but pohutukawa progressively shades out other taxa to become the dominant angiosperm forest visible today. Nearly all the taxa decline was focused on tree species that effectively disappear from the pollen record. This reduction in taxa followed by stasis, coincides with the abrupt increase in charcoal that is also followed by stasis. Extending through to the present, these changes most likely reflect anthropogenic deforestation associated with initial arrival by Māori and their ongoing use of the island. After people left the island the number of taxa remained at a constant 25-35 due to the expansion of pohutukawa and to the Department of Conservation's ongoing weed control program which limits the arrival of new taxa in historic times.

4.2.5.2 DisturbedPlant Species

As a group the disturbed plant species all show an initial expansion due to anthropogenic deforestation opening up the ground to sunlight. These initial succession species remain the primary pollen producers for about 500 years until they are shaded out by the developing pohutukawa canopy. The replacement of pre-human forest species with first succession disturbed plant species is best explained by an anthropogenic fire event because (i) it is accompanied by the sudden appearance and ongoing presence of significant quantities of charcoal and (ii) because the dominance of disturbed plant species for 500 years can only be explained by regular and ongoing fire events and (iii) by their replacement by pohutukawa as the first succession tree species only after the island is abandoned. The fact that uninterrupted regeneration by tree saplings in poor hill soils causes bracken fern to be shaded out within 5-20 years (Druce, 1957) suggests that individual burning events on this more temperate island could not have been more than 20 years apart. Accumulation rates of pollen are not rapid enough to allow fine enough temporal resolution at 5-10 year intervals and so it is not possible to identify how many fire events occurred within each 20 year cycle, but the increase in sedge pollen and bracken fern spores from a low constant to a higher constant later in the Māori phase hints at an increase in burning intensity, and by proxy in gardening intensity, in these cycles late in prehistory.

4.2.5.3 Macro Charcoal

The presence of charcoal spikes within the macroscopic charcoal record most likely reflects individual fire events that are anthropogenic in origin. Its correlation over nearly 500 years with the disappearance of tree species and the presence of only first succession plants that colonise disturbed soil can be best explained by ongoing burning events that are regular enough to stop canopy recovery. The absence of macroscopic charcoal at one point within the record hints – but cannot prove - that anthropogenic burning halted for 30-40 years after the Kaharoa eruption of 1314 AD. It is only after the island is abandoned in 1823, and the deliberate and regular burning required by Māori horticulture stopped that a major decline in charcoal occurred, as pohutukawa began to progressively replace the disturbed plant species. After this date the presence of isolated macroscopic charcoal spikes within a severely depleted microscopic charcoal record most likely reflects historic fire events in European times when the island was not occupied or otherwise utilised by Māori.

4.2.5.4 Volcanic Tephra

Analysis has confirmed the presence in this sediment core ofKaharoa tephra and has located another tephra whose stratigraphic placement, and association with bulk charcoal radiocarbon dates, is consistent with it being of Taupo origins. Both of these are useful independent methods for dating this core. Located so far away from the centre of these volcanic eruptions, the Poor Knights Islands only experienced minor quantities of ash fall, and no associated burning. As such there are no consistent and obvious relationships between the two eruption events and changes in vegetation record (Figures 4.4 to 4.8). These changes are instead caused by anthropogenic activities.

4.2.6 Section Conclusion

Since the soil on Aorangi Island was too dry to preserve pollen the only successful core was taken from Tawhiti Rahi and so it was not possible to compare and contrast the vegetation histories of these two islands. The preservation of pollen recovered from the successful flax core was poor due to the relatively aerobic soils encountered however the diversity of pollen recovered from the flax core on Tawhiti Rahi was surprisingly high despite many grains showing signs of degradation. These enabled a continuous 1900 year vegetation sequence to be reconstructed.

The pollen and charcoal analysis identifies three phases of vegetation. First, Nikau and rimu dominate a mature hardwood-podocarp forest. Second, fire events become significant and the pre-human forest is replaced by only a few first succession species such as sedges, liverworts, grasses and bracken, while the land was used for gardening. Finally, thesesuccessional species are replaced by a non-climax forest of pohutukawa that currently forms a canopy over the whole island. The calibrated 95% date ranges from charcoal extracted from soily peat and bulk peat samples, only show that anthropogenic burning occurred 'early' and finished 'late'. If however the Bayesian modeling of these dates (that includes independent tephra dates and known historic events) is correct, then changes in the charcoal and pollen record can be more precisely located, showing that people arrived and began burning the islands a few decades before the Kaharoa eruption of 1314 +-12 AD. The fire induced replacement of many mature forest species with first succession disturbed ground species lasted for nearly 500 years. Along with an unprecedented increase in the presence of charcoal, this is interpreted as a proxy for 500 years of anthropogenic burning associated with gardening. Specifically, the pollen and charcoal evidence show burning occurred regularly at least once every 20 years. This is a conservative estimate based on data collected in colder New Zealand climates and it is very possible that the guano-enhanced fertility of the rhyolitic soils in this warmer setting would have required burning to have occurred every one to five years for the pollen to not include second succession species. The regular occurrence of fire over such a long period can only be explained by human agency.

Anthropogenic burning is consistent with horticultural ground clearance practices used by Māori. Exactly what is being gardened is not clear. An assumption made here is that at least the initial burn was to prepare the ground for kumara cultivation, and that formal gardens were clearly in place late in the prehistoric sequence. What role other exotic or native cultigens took in the middle part of this scenario is not addressed by the pollen study. The well documented abandonment of the Tawhiti Rahi in 1823 is reflected by the end of regular burn events and the replacement of succession plant species with pohutukawa forest whose canopy currently covers the island.

4.3 Part III: Presence and absence scenarios in introduced biota

This section looks at the absence of the introduced Polynesian rat and the presence of the introduced European pig on to the Poor Knights Islands. The 'presence' and 'absence' scenarioscreatedare used to discuss both the dating and nature of human settlement on these islands.

4.3.1 Kiore

The Polynesian rat kiore is one of a number of commensal species carried by Polynesians during their colonisation of the Pacific. Along with the chicken, dog and pig, one or more of these animals was present in all Polynesian societies at the time of European contact. In New Zealand only the rat and dog became established after initial arrival around 1300 AD (Davidson, 1981; Wilmshurst and Anderson, 2008). Unlike the dog, kiore rapidly established feral populations, and apart from the morepork (*Ninox novaeseelandiae*)there was an absence of predators and so their population irrupted throughout mainland New Zealand (Wilmshurst & Higham, 2004, Wilmshurst & Anderson, 2008). Many ethnographic accounts discuss the significant effort expended by Māori to protect maturing crops in gardens against European introduced rats. These include the use of traps and also the storage of the harvested crops in rat-proof raised structures such as Pataka (E.Best, 1976). It is unclear how much of a threat kiore were to horticultural production in prehistory, but recent studies have shown that although not as dangerous as the Norway or ship rat, kiore on islands do have a major effect on the natural environment. They have been shown to suppress the establishment viability of 11 species of coastal broadleaf plants, a wide selection of flightless invertebrates, skinks, tuatara, and small seabirds, and may significantly modify forest composition (various authors cited in Towns, 2003: 379). It is not unreasonable to assume that in large enough numbers kiore would have predated cultigens in the same way that European rats do. By the time of European contact kiore was a mixed blessing for Māori. On one hand they remained a minor animal protein delicacy but on the other hand, the wild kiore, would have been a threat to traditional horticulture.

The distribution of kiore on inshore and offshore islands is strongly correlated to human transportation since this rat is a poor swimmer, with a maximum swimming range of only 130m (Whitaker, 1974). What is interesting is that within the northern New Zealand coastal region there are a significant number of large and small inshore and offshore islands where kiore are not found (Atkinson, 1986; Taylor, 1989). Looking at 200 islands that are 0.8ha or larger in size and located 200 or more metres from the mainland, Atkinson identified 49 (25%) that were definitely free of all rodents, 33 (17%) that had kiore present, 38 (19%) with a range of European rodents present, and 80 (40%) for which rodent information is either lacking or containing unidentified rodent species (Atkinson, 1986: Table 2). Restricting the data to the 31 offshore islands in northern New Zealand that all contain prehistoric archaeological landscapes and that individually or in a group are over 100ha in size, this shows 10 kiore free islands (33%), two for which rodent information is lacking, and 19 with kiore. The patchwork pattern of kiore presence and absence on offshore islands has sub-variables. Of the nine island groups off the east coast of the North Island (Figure 4.9), only two completely lack kiore (Poor Knights & Three Kings). Some island groups have individual rat free islands. These include Marotere (Chicken Islands) Motukawaiti (Cavelli), Ruamahuaiti, Raumahuanui and Hongiora (Alderman's), and Moutuhora (Bay of plenty). The only inshore island that is free of kiore is on Otata Island (Noises Island) in the Hauraki Gulf (Atkinson 1986:23; Taylor 1989). Table 4.3 identifies the presence and absence status of kiore on all these northern islands.

The data showing some islands having kiore and others not raises the question as to whether the introduction of kiore by Māori was a deliberate act to establish a food source, or whether kiore distribution was a result of accidental dispersal. Knowing which of these arguments best explains the rat-free status of the Three Kings and Poor Knights offshore island groups will give insight

Table 4.3 Presence or absence of kiore (Rattus exulans) on offshore islands or island groups >100ha in size and located >5 km offshore.

Island groups	**Island names**	**Area (ha)**	**Distance offshore**	**Ownership**	**Rattus exulans [K]**	**Rattus rattus [RR]**	**Rattus Norvegicus [RN]**
Barrier Islands	Kaikoura	535	17.9	Freehold	?		
	Aotea	27761	17.9	Crown/Māori/Freehold	K	RR	
	Hauturu	3083	17.9	Crown (DOC)	K		
Bay of Plenty	Motiti	690.5	8.6	Māori/Freehold	?		
	Whakaari (White)	313	47	Freehold	K		
	Moutohora (Whale)	172.6	7.1	Māori	Not present		
Alderman Is	Middle Chain Island	23	13	Crown (DOC)	K		
	Hongiora	16.25	13	Crown (DOC)	Not present		
	Raumahuaiti	25	13	Crown (DOC)	Not present		
	Raumahuanui	32.5	13	Crown (DOC)	Not present		
Coromandel	Tuhua (Mayor)	1311	26	Māori	K		RN
Hen & Chickens	Coppermine Island	79	10.2	Crown/Freehold	K		
	Mauitaha	28.7	10.2	Crown (DOC)	K		
	Whatupuke	101.9	10.2	Crown (DOC)	K		
	Taranga (Hen)	500	10.2	Crown (DOC)	K		
	Marotere (Lady Alice)	155	10.2	Crown (DOC)	K (late?)		
Mercury	Ahuahu (Gt Mercury)	1860	4<	Freehold	K	RR	
	Double Island	20	5.52	Crown (DOC)	K		
	Kawhitihu (Stanley)	100	5.52	Crown (DOC)	K		
	Whakau (Red Mercury)	225	5.52	Crown (DOC)	K		
	Moturehu	32	5.8	Crown (DOC)	K		
	Repanga (Cuvier)	170	14.85	Crown (DOC - part)	K		
	Ohinau	43	4<	Crown (DOC)	K		
Mokohinau	Burgess Island	55.6	30	Crown (DOC)	K		
	Fanal Island	75	30	Crown (DOC)	K		
Poor Knights	Aorangi	110	14.9	Crown (DOC)	Not present		
	Tawhiti Rahi	163	14.9	Crown (DOC)	Not present		
Three Kings	Great King	407.5	56.5	Crown (DOC)	Not present		
	Moekaua (SW Island)	40	56.5	Crown (DOC)	Not present		
	Ohau (W Island)	16.25	56.5	Crown (DOC)	Not present		
	Oromaki (NE Island)	10	56.5	Crown (DOC)	Not present		

Compiled from tables 3, 5 and 6 in “A Register of Northern Offshore Islands and a Management Strategy for Island Resources’ (Taylor, 1989).

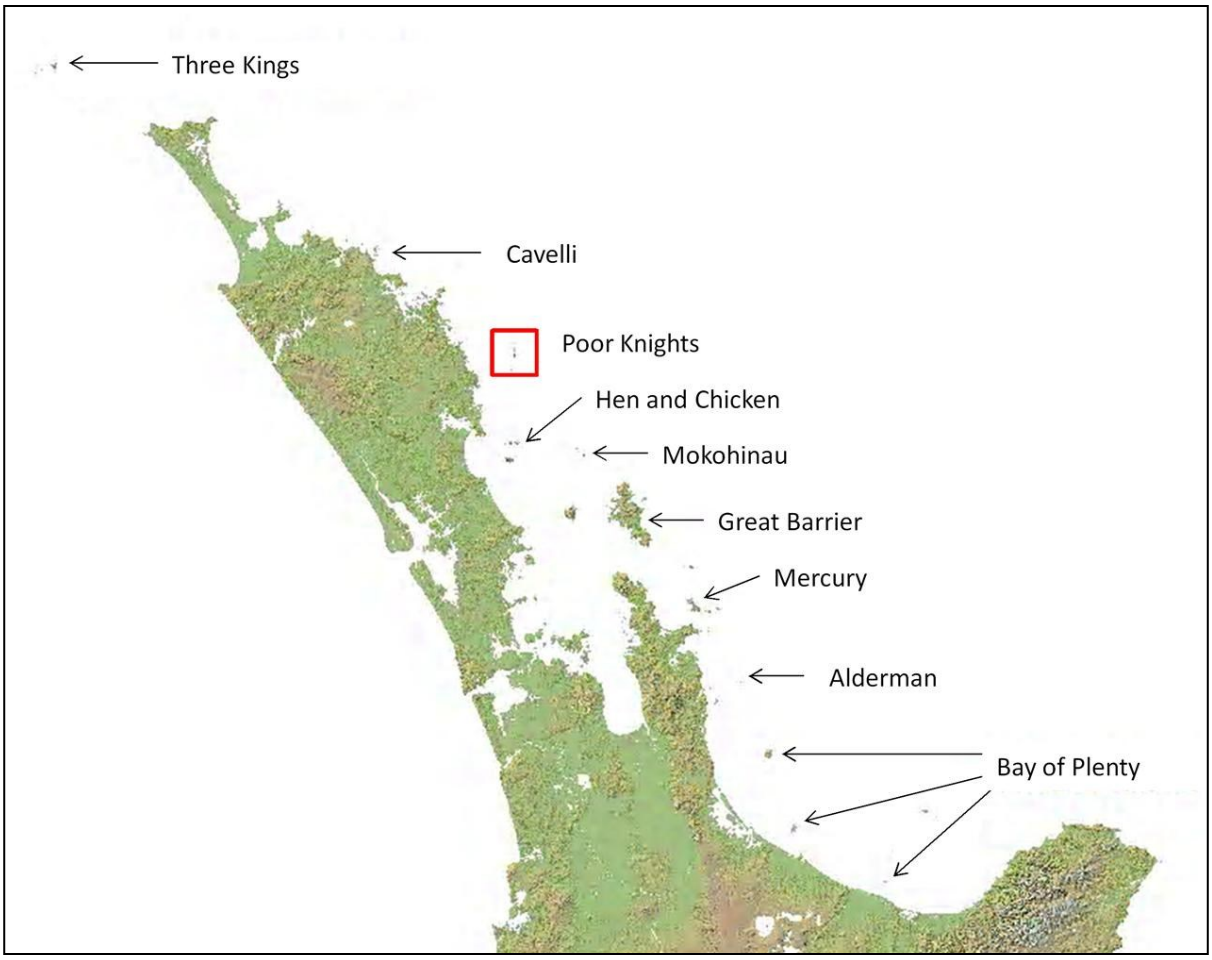

Figure 4.9 Nine groups of offshore islands along the north-east coast of the North Island, New Zealand

into the dating of island use by Māori (the 'when' question) and the nature of this use (the 'why' question). Therefore the questions relevant to kiore free islands are;

1. Is it accidental that kiore are not present on these islands?
2. Or is their absence a deliberate exclusion by Māori, and if so why?

4.3.1.1 Kiore Presence and Absence on Islands

Kiore were deliberately brought to New Zealand by the Polynesian settlers. It is unclear if kiore were domesticated like dogs, but they were definitely eaten and considered a delicacy by Māori (Davidson, 1984, 129). Once here, the spread of kiore through mainland New Zealand did not require human agency, and can be explained by natural increase in a feral population entering an environment that had only native owls and humans as predators. But kiore are poor swimmers and could not have made their own way to inshore and offshore islands more than 200m from the mainland, their presence on any island indicates human agency. In the nine offshore island groups located aslong the North Islands east coast, four have kiore present on all islands; three have some islands with kiore present; and two groups have no kiore present. Finding kiore on only some of the islands known to be used by Māori therefore creates another presence and absence scenario and begs the question as to whether this was a result of deliberate or accidental actions.

Looking at the nine offshore island groups along this east coast, Atkinson notes that the two island groups completely without kiore (Three Kings & Poor Knights) had encircling cliffs and therefore more difficult landing arrangements than other island groups where kiore are present (Atkinson, 1986:23). This idea that access difficulties inhibited kiore establishment implies that kiore introduction was accidental. However there are also a number of easily accessible islands without kiore such as Moutohora Island in the Bay of Plenty where the reconstructed vegetation history (Wilmshurst, 1998) indicates a long history of human use and where the chances of accidental introduction of kiore must have been high but did not occur. This suggests that the absence of kiore might be the result of deliberate human action.

Looking at island groups that contain islands both with and without kiore, perhaps the presence of kiore on at least one of the three islands in the Bay of Plenty group and two of the five islands in the Alderman Islands reflects deliberate introduction to some islands and the deliberate exclusion of rats to others in a group. It could also reflect deliberate or accidental introduction to one island and then an ongoing process of accidental distribution to the other islands. A complicating factor is that a successful colonisation of an island by kiore only requires one pregnant rat. There may well have been islands Māori deliberately kept free of kiore, but which by a single accidental event became kiore colonised.

In regard to the timing of kiore arrival on islands, it should be recognised that the current data showing the presence or absence of kiore on islands does not necessarily reflect the prehistoric situation. For example there is a surprising absence of kiore on inshore islands in the Bay of Islands and the Hauraki Gulf that are known to be the focus of Māori settlement throughout the prehistoric sequence. However this absence correlates strongly with the historic presence of ship rat (*Rattus rattus*) andNorway rat(*Rattus norvegicus*) (Atkinson 1986: Table 2). Since these European rat species are known to outcompete kiore, it is likely that kiore were once present here but became extinct in historic times (Atkinson, 1986:22). Another example of a mismatch between prehistoric and historic rat data is the colonisation of kiore on Marotere (Lady Alice Island) in the Hen and Chicken group. The recent arrival of kiore on this island in the historic period was identified through a study of dune stratigraphy that found native Placostylus snails with rat chews occurred from the surface only down to a dated depth that coincides with an early 19th Century introduction (Brook, 1999). Some other lines of evidence that corroborate this finding are the steady decline of some smaller species of seabirds (when compared with historic records), the relative abundance of tuatara (quite numerous on Lady Alice Island but nearly extinct on Taranga Island that does have kiore), and the presence of Norway rat parasites on the kiore. The latter can be accounted for in two ways. First that Norway rats and their parasite livestock escaped onto Lady Alice Island and died out only after infecting kiore already established there. This is unlikely as no other examples of islands with European and Polynesian rats present have neverresulted in European rat extinction. The second and more likely option is that kiore arrived on this island after Norway rats had invaded the mainland post 1769. There is ample opportunity for European rat mites to transfer to their New Zealand counter-part since kiore and Norway rats coexisted for more than 100 years on the New Zealand mainland before the arrival of other animal predators associated with European settlement caused the kiore to become extinct (Towns, 2010).

For the prehistoric period if we are (i) correct in the assumption that the absence of kiore on the primary inshore islands of the Hauraki Gulf and the Bay of Islands was probably caused by kiore being outcompeted by European rats, and (ii) correct also for the late presence of kiore on Lady Alice Island in historic times, then a minor correlation emerges of kiore being present on all inshore islands and kiore being absent on one or more islands in some of the smaller offshore island groups. Without rat-chew studies being carried out on all kiore inhabited islands it is not currently possible to determine at what period in prehistory kiore arrived on these islands, however the Marotiri data suggests that for some islands this arrival was after European arrival.

4.3.1.2 Discussion

Discussion:

For the study area of the Poor Knights offshore island group we know that difficult access, limited water supply and a location some distance offshore are likely to make these places a peripheral environment for Māori habitation. The complete lack of rats is an important datum in this picture. Anderson notes that there is a correlation between kiore free islands and islands lacking any type of archaeological remains of occupation (Anderson, 1996:407), however this cannot explain the Poor Knights, where there are no kiore but extensive archaeological remains are found. Whether or not rats were deliberately or accidentally excluded, the fact that they never became established has implications for the timing (when?) and/or the nature (why?) of human settlement. These environmental circumscriptions and absence of kiore suggests that Māori use of Tawhiti Rahi is best explained through two scenarios;

1. Island use was long term and low intensity, reflecting a seasonal resource area providing garden outliers and perhaps mutton-birds or other collectable resources. In this scenario the deliberate introduction of rats as a food resource was not necessary for the small number of people intermittently visiting the island. This argument supports a low risk of accidental kiore introduction over a long time frame.

2. Island use was short term and high intensity, reflecting full habitation by Māori late in prehistory. The negative impact of kiore on both mutton-bird colonies and gardens was now understood and therefore the large resident human population actively excluded rats to protect both crop and bird resources. This argument supports a high risk of accidental kiore introduction but over a very short time frame.

These scenarios are not necessarily mutually exclusive. If either or both scenarios occurred then, this would reflect a change over time in the pattern of human settlement on this island. Whatever actually happened, the deliberate or passively exclusion of kiore tells us that compared to inshore islands, peripheral islands like the Poor Knights are being used in different ways by Māori in prehistory.

4.3.2 European Pig

The presence of the European pig on Aorangi Island is significant in a number of ways. First, pigs and potatoes were adopted early by Māori as trade goods with Europeans (Ballara, 1998; Belich 1996). Therefore the presence of pigs on islands circumscribed with difficult access and limited fresh water, suggests that even islands on the periphery of Māori society may have been engaging, directly or indirectly, in the provisioning of the whaling fleets that came to the coast of Northland in the early 1800s. Second, pig presence also indicates that prehistoric Māori settlement continued into the historic period. Finally, that the presence of pigs on Aorangi but not Tawhiti Rahi Island creates another presence and absence scenario that needs explaining.

4.3.2.1 Trade Goods [the 'why' question]

In the first decade after rediscovery European explorers including Cook, de Surville and du Fresne introduced a wide range of plants to Māori in both the South and North Islands of New Zealand. These included wheat, maize, potatoes, peas, rice, carrots, parsnips, cabbages, onions, leeks, parsley, radish, mustard, broad beans, kidney beans, turnips and yams. Animal introductions at this time were limited to goats, pigs, and chicken (Petrie, 2012:1). The success of these introductions varied, but in the North Island, pigs and potatoes were initially the most important food sources brought by Europeans. This was due in part to their easy fit into traditional Māori society, since potatoes could be grown in ways similar to kumara but with much higher productivity, thus providing the first reliable food surplus (Belich, 1996:159). Similarly pigs being fast growing, omnivorous and able to forage for themselves had obvious advantages as a fat and meat source compared to the Polynesian rat and dog that were the only other terrestrial mammal available to Māori (Petrie, 2012:2). Pigs also then provided a meat surplus that paralleled the potato surplus.

Potatoes are known to have been grown at New Zealand at Thames in 1801, and were traded with European ship visits as early as 1805 in the Bay of Islands in the north of New Zealand (Petrie 2012:2). The movement of such resources was often in advance of actual contact with Europeans, and by 1820 had even reached remote areas such Muriwai on Auckland's west coast. Marsden, the first European visitor, noted a change in their diet with

> "….fresh potatoes, and….some hogs…" (Elder, 1932:316).

It is likely that the purpose of pigs and potato'swas principally as trade items that could be exchanged for European goods. For visiting ships needing re-provisioning, pork could be cask preserved with salt, while the white potato could be hung in nets under decks where - unlike the kumara (sweet potatoe - *Ipomoea batatas*) – they stored well. This combination of pigs and potatoes became even more important as a trade item that could pay for the escalating introduction of muskets into New Zealand, which at the time of greatest demand and lowest supply in 1812, could cost Māori eight large pigs and 150 baskets of potatoes (Belich 1996:152). During the musket wars between 1818 and 1827 a feedback model developed whereby war parties bought guns with these goods and then went raiding, bringing home slaves to work the potato fields so that more guns could be bought. Pigs did not require much care as they were often semi feral living off fern root and other items they could scavenge. This quickly led to the destruction of crops by scavenging pigs, and significant efforts were made to exclude the pig from gardens by fencing as reported in the Bay of Islands as early as 1814 (CMR 1838: 85 cited in Hargreaves, 1963: 111-112). The placement of pigs on offshore islands beyond their ability to escape by swimming has two benefits; first it uses island circumscriptions in the form of a sea barrier to confine them away from mainland or other island gardens and secondly makes them easier to catch when required. It is in this context that the presence of pigs on Aorangi Island is significant.

4.3.2.2 Chronology [the 'who and when' questions]

Oral traditions included in Fraser's ethnography of the Poor Knights mention pigs on Aorangi Island in the early 1800s and record that a dispute over them circa 1808 was reputed to be the cause of inter-tribal conflict that occurred in 1823 (Fraser, 1925; see also Chapter 3). Since pigs were not brought to New Zealand by the Polynesian settlers, but rather were introduced after European contact began, this raises questions as to who brought them and when did this occur?

It must have happened sometime in the 54 years between Cook being the first European to rediscover New Zealand in 1769 and before the inter-tribal attack of 1823 that directly led to the islands being declared tapu and abruptly abandoned by Māori. Cook himself is reputed to be the source of pigs on Aorangi (Fraser, 1925:8) but despite Northlanders still referring to large wild pigs as 'Captain Cookers' he is only recorded as introducing boars and sows into Queen Charlotte Sound and Hawkes Bay but never into Northland (Heap, 1961; Petrie, 2012:1). In 1769 the French explorer de Surville did gift two pigs to local Māori at Doubtless Bay, but there is no record that this small introduction led to a viable breeding population (Petrie, 2012:1). The most likely source of European pigs to Northland is from the Governor of New South Wales, Phillip King, who was based at Norfolk Island between 1791 and 1795 (Heap, 1961). At the time this island was a small penal colony with a large population of both military, settlers and convicts who raised crops and bred farm animals – in particular pigs. King reported 14,642 swine present in 1795 (Midgley, 2014). After returning the kidnapped Tukitahua and Huru to New Zealand in 1792, King gave Tukitahua 12 pigs as part of an attempt to establish a secure whaling base in New Zealand (McNab, 1914:85). For over 10 years King sent a number of ships with livestock (including 56 pigs) and crops to provide local Māori with trade goods to assist with the establishment and support of British whaling. However it was only with the support of the Ariki Chief Te Pahi that a successful breeding population of pigs was established in 1805. By 1808 there was for the first time a surplus of pigs available for trade (Belich, 1996:146; Petrie 2012:1).

With the Poor KnightsMāori population being neighbours to the Southern alliance of Ngapuhi, it is likely that the pigs on Aorangi originated directly or indirectly from this part of the Bay of Islands, probably as gifts sometime after 1808, – the earliest time that a surplus of pigs could be available. If this scenario is correct, then pigs were present on Aorangi for at most 15 years. Following the depopulation of these islands in 1823, a small number of pigs presumably remained alive on Aorangi, forming a viable feral population. This population significantly modified the island's fauna and flora and likely caused the extinction of the Placostylus snail colonies located there. They also significantly reduced the range and number of ground-burrowing birds, and caused the regenerating flora of the island to take a different form from that occurring on the adjoining but pig free island of Tawhiti Rahi. By the early 1900s scientists who valued the unique fauna and flora of the Poor Knights were soon expressing concern about the negative impact the pigs were having and from 1914 onwards various attempts were made to eradicate them from Aorangi by hunting. Despite the island's small size the hunting parties were unsuccessful in killing all breeding pairs, and the pig population always recovered (Fraser 1924). It was not until 1936 that a well-planned expedition by Captain Yerex finally eradicated the last seven pigs on the island. Yerex noted that the pigs were of the Berkshire type, and confirmed that they were only resident on Aorangi Island and not on the adjacent island of Tawhiti Rahi (Yerex, 1936). The spectacular increase in breeding populations of petrels on Aorangi after the pigs were finally killed off (Medway, 2001:87) shows that ground dwelling mutton-bird colonies are not viable in the presence of uncontrolled pig populations.

Since the 1990s the Poor Knights Islands have been the focus of a Department of Conservation weed removal program designed to stop the invasion of noxious plants (such as moth plant) that could endanger the local flora. As part of this process, weed parties regularly traverse the islands. On Aorangi the parties reported numerous locations of pig bone that most likely date from between 1808 and 1936. In 2010 a visit was made by the author to Aorangi Island to recover samples of pig bone for identification and sourcing. Using the weed team's spreadsheet a 2x2m spread of pig bone at site A011 in the Puweto valley catchment was relocated. Samples were taken of key elements and it was noted at the time that the bones were mostly broken. From this it is suggested that this individual died after the Māori abandonment of 1823 and was either a natural death or was one of the shot pigs from the extermination expeditions that occurred between 1900 and 1936. Using the comparative faunal collection held in the University of Otago Anthropology and Archaeology Department the bone was confirmed as being pig. The large stature of this pig along with the complete absence of the smaller Polynesian pig from New Zealand in prehistory, confirms that this population was of European origin.

4.3.2.3 Pigs and Mutton-Birds

The introduction of pigs by Māori to islands in the early 1800s was likely to have been a common occurrence. Examples within the region include at least seven of the smaller islands off the west coast of Aotea being used as 'motu poaka' (pig runs), with each being owned by a particular hapu or whanau, and being under the mana and control of specific rangatira (chief) (McMath, 1995, 28). For the Poor Knights Islands, the presence of pigs on Aorangi and their absence on Tawhiti Rahi could be due to differential access to an available and transplantable mainland pig population, although this seems unlikely since the hapu on the two islands were related. Another possibility is that Tawhiti Rahi was deliberately left free of pigs so as to protect the Buller's

Shearwater breeding colonies that seasonally provided mutton-birds. As discussed previously, ground-dwelling sea birds were common on both the mainland and islands of New Zealand at the time of Polynesian arrival. The Buller's Shearwater , known as 'rako' to Ngatiwai iwi, only breeds on the Poor Knights Islands and therefore is likely to have increased in importance over time as mainland seabird colonies disappeared due to human hunting and rat predation. Ethnographic information collected 100 years after the abandonment of the island group in 1823 explicitly stated that mutton-birding of the Rako occurred, that adult birds were protected, and that breeding colonies were restricted to the coastal cliff zone (Fraser, 1925). Historic mutton-birding data from the adjacent Mokohinau Islands recorded in the 1880s suggest that many thousands of fat rich juvenile birds of another burrowing seabird species - the Grey-Faced Petrel (*Procellaria gouldi*) known to the Great Barrier Māori as the 'Oii', were annually collected and cooked in their own fat for storage (Sandager, 1889:292). It is assumed conservatively that at least similar numbers of fat rich Rako would have been taken from the much larger colonies on the Poor Knight's Islands, sometime after hatching in January and before fledging in May (Harper, 1983: 243). The importance of mutton-birds has always been difficult to quantify since there is no known and unambiguous archaeological data that can show where and how their collection and processing occurred. Similarly the faunal midden material examined found no confirmed cooked sea bird bone. Implications for timing of settlement based on such negative data are open to review, but it is worth mentioning that this absence of mutton-bird bone (Chapter 5 Part III) is not consistent with early Polynesian bird collection and cooking practices, but is consistent with late historic mutton-birding cooking and preserving practices(Anderson, 2005:795; 2006).

If the pig absence is correlated to the mutton-bird presence on Tawhiti Rahi Island and vice versa on Aorangi Island then it is possible that in the prehistoric period the deliberate conservation efforts made to keep the island rat-free were extended to keep Tawhiti Rahi and its larger mutton-bird breeding grounds free of pigs. The introduction of pigs onto Aorangi may reflect a deliberate choice to establish a breeding colony. Lawlor argues that, since people inhabited Aorangi when the pigs were introduced, the boundary wall and modifications to older terrace and wall features at Urupa Pt reflect an attempt to exclude pigs from the habitations, garden areas and mutton-bird resource zones on the remainder of the island (Lawlor, 1988:8). The loss of only a small part of the island to accommodate the new pig colony was probably seen as an acceptable cost in return for the benefits in trade, food and mana brought by the pigs.

White potato became established in Northland at the same time as pigs and often they are seen as partner trade items. It is possible that attempts were made to establish potato on one of more of these islands, although the lack of any ethnographic and archaeological evidence for its presence on the Poor Knights Islands does not allow this possibility to be assessed. Successful development of a plant DNA methodology (currently being developed – see earlier in chapter) will be needed to determine if this did in fact occur on one or more of the Poor Knights Islands.

4.4 Conclusion

The key fact from kiore distribution data is that somehow a number of islands remained rat free in prehistory. Looking at our study area of the Poor Knights, this absence of kiore on both Tawhiti Rahi and Aorangi, whether deliberate or accidental, is consistent with either long term low intensity intermittent use perhaps as a garden outlier for a non-resident population, or withshort term high intensity use as a permanent settlement by a resident population late in prehistory on these environmentally circumscribed and constrained islands. It is not consistent with significant long term high intensity prehistoric settlement by a resident Māori population. However the sediment core based 1900 year vegetation history indicated that at least on Tawhiti Rahi, just such a long term horticultural use did in fact occur here, that it started early in prehistory, that there were no clear breaks in this settlement for 500 years, and that the presence of European pig bone on the cave floor shows that this usagecontinued into the historic period.

One explanation for these apparently contradictory evidence of long term gardening but no rats present, is that island use changed over time. In this scenario the absence of kiore from the Poor Knights Islands is consistent with the environmentally constrained nature of certain offshore islands as long as initial use was as a garden outlier by a non-resident population who did not stay long enough for kiore to be accidentally introduced. Later in prehistory there is a fundamental change in the settlement pattern from garden outlier to full settlement,wherekiore were deliberately excluded because of their known negative impact on both gardens and mutton-bird colonies. The historic introduction of the European pig to only Aorangi possibly provided a new meat resource while protecting the larger mutton-bird meat resource on Tawhiti Rahi.

The environmental data discussed in this chapter engages with the three questions asked in this thesis about who occupied Tawhiti Rahi Island, when it was occupied, and why this occurred. It is argued here that the presence and absence of certain animal species and the reconstructed vegetation history from the palynology are best explained by a scenario of long-term use by Māori focused primarily on horticulture with a secondary focus on mutton-birds. The evidence of burning in the pollen core is indirect evidence of gardening activities that started early and continued throughout prehistory. When the evidence from the core is integrated with the rat and pig data this suggests that the use of Tawhiti Rahi changed over time from an initial low intensity garden outlier for a non-resident population, to intensive occupation by a resident population late in prehistory and that this occupation continued into the early historic period.

Chapter 5 will now examine the third part of this multi-disciplinary study – the archaeological data - to see what it can tell us about the nature and timing of human occupation on this island.

Chapter 5: Archaeology Results

"They are most interesting Islets and would repay a month's residence by interested men. By this I mean botanists and zoologists." Capt. John Bollons. Letter to the Marine Department 8/09/1922

"The practicing of horticulture on a fairly large scale implies that an attempt, or a number of attempts have been made to settle for some duration on Tawhiti Rahi and Aorangi. It is suggested that such occupations would have been irregular and short lived in the prehistoric period proper due to the restricted variety and nature of the groups resources." Steven Edson, 1973, pg. 77 Human ecology and prehistoric settlement on some offshore Islands (East Cape to Cape Reinga), New Zealand. MA Thesis, University of Auckland.

"…a major archaeological survey of the Poor Knights Islands would uncover many interesting finds and would provide historians with a less prejudiced picture of the Māori before the arrival of the Europeans."
J.A. (Sandy) Bartle, Northern Advocate 12/01/1972

"(Archaeologists have)…..regarded Polynesian society as dynamic from the arrival of the first canoe in New Zealand…..(There is a need for)……archaeologists to investigate specific early communities in depth."
Angela Ballara, 1998, pg. 36 Iwi: the dynamics of Māori tribal organisation from c.1769 to c.1945

5.0 Background

From 1906 when Cockayne and Captain Bollons made the first documented landing by Europeans on the Poor knights (Cockayne, 1905; Bollons 1922), scientific research on and around the islands has been dominated by a focus on the natural sciences such as botany, geology and marine science. The first real interest in the islands cultural values was shown by Fraser and by Oliver (1925:380) in the early years of the 20th century. Fraser in particular made a number of visits to the islands between 1914 and 1924, during which he noted the existence of extensive stone work that he interpreted as being associated with cultivation areas, habitation terraces and defensive ramparts (Fraser, 1925:10). It is fair to say that up until the 1980s, the main focus of historic research in this island group has been on Aorangi Island (Cockayne, 1906; Bollons, 1922; Oliver, 1925; Fraser, 1925; Cochrane, 1954 and 1957). This preference for the smaller southern island and the view that Tawhiti Rahi either had no archaeology (Fraser, 1924:8) or limited archaeology (Cochrane, 1957)may be due to two factors. First, that Aorangi Island had easier access from the sea and second, that unlike Tawhiti Rahi the archaeological features there were exposed due to significant reduction of the under-story vegetation by feral pigs.

From 1964 onwards there was a growing interest by archaeologists in the islands that has continued to the present (Leahy & Nicholls, 1964; Lawlor, 1977, 1979; Haywood: 1981, 1993; Robinson, 2004) (Table 5.4). The first systematic attempt to survey Aorangi and Tawhiti Rahi was made during a Whangārei Museum visit in 1964 by archaeologists Leahy and Nichol who were accompanied by New Zealand Archaeological Association Northland File Keeper Mr. Stan

Bartlett. This brief visit of 3 days recorded a total of 21 sites and set out nine types of stone structures specific to these islands (Leahy and Nicholls, 1964:107). Later that same year a multi-disciplinary scientific project that included archaeology commenced. This carried out research on the Poor Knights Islands between 1964 and 1975 (Harper et al, 1964; 1975; 1983). In 1974 Edson, in his MA thesis, compiled all existing survey data and restated NZAA Northland File Keeper Mr. Stan Bartlett's comment that the islands still had not been comprehensively surveyed (Bartlett, 1964; Edson, 1974). To remedy this Lawlor made visits in 1976, 1978 and 1979 and produced the first comprehensive survey of Aorangi. He noted that despite varying degrees of feature concentration, the whole island was effectively one site (Lawlor, 1977). From the time of Leahy and Nichols onwards, the surveying archaeologist faced significant technical problems when attempting to record sites located any distance away from the access tracks on to the islands (Bartlett, 1964: 7; Leahy and Nichol 1964: 101). These problems included contiguous archaeological features with repeating feature types, a 2-12 m high native bush canopy that drastically limited visibility on the ground, and most importantly, a lack of a suitable topographical map to provide a spatial context for recording sites (Lawlor, 1988: 3, 18 [footnote 6]). Despite these difficulties, Lawlor's use of aerial photographs and dead reckoning, radio communication between his survey parties and a team who had pre-existing local knowledge of site locations, allowed him to produce a 'broad brush' survey of Aorangi. They recorded the general extent and location of site areas and, within these, identified site types and recorded features that he considered to be unique or representative. Although 'tape and compass' recording of the whole island was not practicable, he did use this technique to accurately record some of these special sites such as Tatua Peak (R06/13) (Lawlor, 1977).

In the late 1970s attention turned to the larger island of Tawhiti Rahi with a survey by Lawlor in 1979 and two surveys by the Offshore Island Research Group in 1980 and 1984 (Lawlor, 1979, 1988 unpublished; Hayward, 1993). Unlike Aorangi which had suffered unconstrained pig browsing from 1823 to 1936, the surveyors found Tawhiti Rahi to have always been pig free, which helped explain why it's complex and extensive archaeological stonework features remained relatively well preserved. Hayward was the only researcher since Harper in 1975 to comment about the importance of mutton-birds to the island's

Table 5.1 List of Archaeological Fieldwork on Aorangi and Tawhiti Rahi Islands, 1964-2008

<table>
<tr><th rowspan="2">Fieldwork Date</th><th rowspan="2">Archaeologist</th><th colspan="2">Number of Days</th><th rowspan="2" colspan="2">Number of Sites recorded</th><th rowspan="2">References</th></tr>
<tr><th>Aorangi</th><th>Tawhiti Rahi</th></tr>
<tr><td>1964 (4-7 January)</td><td>S.M. Bartlett A. Leahy E.M. Nicholls</td><td>2.5</td><td>1</td><td colspan="2">21</td><td>Bartlett 1964
Leahy & Nicholls 1964</td></tr>
<tr><td>1976 (27 Nov – 4Dec)</td><td>I.T. Lawlor</td><td>9</td><td></td><td colspan="2">29</td><td>Lawlor 1977</td></tr>
<tr><td>1978 (13-20 May)</td><td>I.T. Lawlor</td><td>8</td><td></td><td colspan="2">4</td><td rowspan="2">Incomplete draft paper, by Lawlor 1988</td></tr>
<tr><td>1979 (19-25 February)</td><td>I.T. Lawlor
S.Black, H. Charters</td><td></td><td>7</td><td colspan="2">3</td></tr>
<tr><td>1980(6-12 September)</td><td>B. Hayward</td><td>7</td><td>7</td><td colspan="2">25</td><td>Hayward 1993</td></tr>
<tr><td>1984(27 August to 3rd September)</td><td>B. Hayward</td><td>8 + small island visits</td><td></td><td colspan="2">19 (R06/63-81)</td><td>Hayward 1993</td></tr>
<tr><td>1999 (2-8th February)</td><td>J. Robinson
J. Maingay
K.Tatton</td><td></td><td>8</td><td>- recon -
carver site
-landing</td><td rowspan="7">*25 previously recorded sites revisited</td><td rowspan="7">Robinson 2004</td></tr>
<tr><td>1999 (29 August – 3rd September)</td><td>J. Robinson
R. Williams</td><td></td><td>5</td><td>- track marking</td></tr>
<tr><td>2000 (17 – 23rd January</td><td>J. Robinson
J.Maingay
B. Jameson</td><td></td><td>7</td><td>- Puketuaho
- w. coast
- carver</td></tr>
<tr><td>2000 (2nd – 10th September)</td><td>J. Robinson
K.Tatton</td><td></td><td>9</td><td>Puketuaho</td></tr>
<tr><td>2001 (7-14th September)</td><td>J. Robinson</td><td></td><td>8</td><td>Puketuaho
- E garden</td></tr>
<tr><td>2005 (18 March – 7 April)</td><td>J. Robinson
J. Carpenter</td><td></td><td>20</td><td></td></tr>
<tr><td>2005 (23 April – 9 May)</td><td>J. Robinson
J. Welch
I. Bruce</td><td></td><td>16</td><td></td><td>PhD research</td></tr>
<tr><td>2005 (26 June – 2nd July)</td><td>J. Robinson
A. Dodd</td><td></td><td>7</td><td colspan="2"></td><td>PhD research</td></tr>
<tr><td>2005 (20 August – 10 September)</td><td>J. Robinson
J. Carpenter
R. Walter
C. Jacombe
I. Bruce
A. Dodd
J. Plummer</td><td></td><td>22</td><td colspan="2"></td><td>PhD research</td></tr>
<tr><td>2006 (2 April – 14 April)</td><td>J. Robinson
J. Carpenter
A. Findlater
M. Turner</td><td></td><td>15</td><td colspan="2"></td><td>PhD research</td></tr>
<tr><td>2005
(2 November)</td><td>J. Robinson
J. Carpenter</td><td>1</td><td>1</td><td colspan="2"></td><td>PhD research
Landcare palynology</td></tr>
<tr><td>2008 (16 – 23 February)</td><td>J. Robinson
I. Bruce
E. Williams</td><td></td><td>8</td><td colspan="2"></td><td>PhD research</td></tr>
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Māori inhabitants. He also endorsed McCallum's view (McCallum, 1981) that today these birds were re-colonising the island's archaeological sites and posed a threat to their long term survival. Despite the constraints discussed above the limited survey of Tawhiti Rahi by both Lawlor and Hayward had identified the contiguous nature of the archaeological landscape (Lawlor, 1977:1; Hayward, 1993:89) although but had developed different ways of looking at it. Hayward for example identified eight specific areas of extensive stonework, 14 small habitation sites, two pa (R06:6 & 18) and a general area of flat or gently sloping land (covering about 40% of the island) without any obvious archaeological modifications that he argued would have been used for cultivation (Hayward 1993:91) (Figure 5.1). Lawlor looked at the same data slightly differently, and divided all the stonework areas and small habitation sites into eight habitation areas and nine cultivation areas, and did not interpret the unmodified areas as gardens (Lawlor,1979, unpublished material 1988) (Figure 5.2).

In summary, survey work by Leahy and Nichol in the 1960s, and Lawlor and Hayward in the late 1970s faced a series of complexities. These included a large and continuous archaeological landscape located for the most part on a plateau with only minor contour variation. To make things worse this was all situated under an obscuring and continuous forest canopy. They lacked accurate maps to work from since the NZMS 260 map series was not produced until the 1980s. Despite these difficulties they produced general site distribution maps at a 1:10000 scale that are broadly accurate and produced a total of 57 New Zealand Archaeological Association (NZAA) site records for the Poor Knights Islands – 32 for Aorangi (R06-30 to 62) and 25 for Tawhiti Rahi (R06-5 to 29). However on Tawhiti Rahi, the only site drawings made were a sketch of the top of Puketuaho (R06-12; Leahy and Nichols), a detailed plan of Quartz Hill (R06-11; Lawlor, 1979) and a plan of the top of the Citadel (R06-18; Haywood, 1980). It was not until Global Positioning Systems (GPS) navigation technology became available that it became possible for individual features in this cultural landscape to be quickly, accurately and comprehensively recorded. Between 1999 and 2001, the Department of Conservation historic staff using small handheld GPS units carried out five weeks of a survey program in an attempt to inventory all of Tawhiti Rahi Island's cultural landscape. This fieldwork identified a far more complex and extensive archaeological landscape than had been anticipated, however there was not the time or resources available to record them properly. Instead, using the GPS, all the previously recorded sites were revisited, and some of the previously identified concentrations of features were recorded to sub 20 meter accuracy and at 1:5000 scale. Large areas requiring far

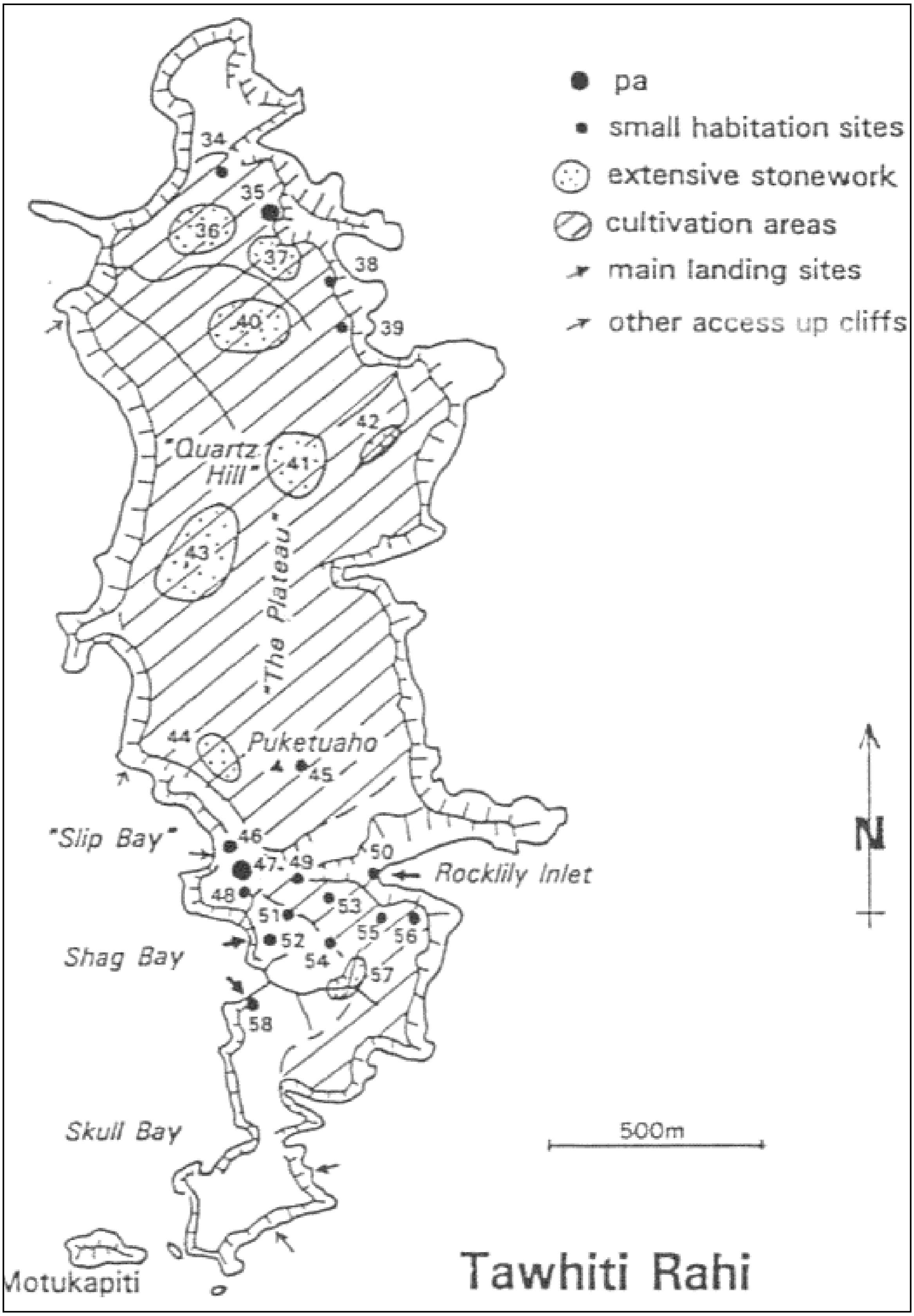


Figure 5.1 Tawhiti Rahi Island survey plan made in 1980 by Hayward (1993:91), shows all recorded archaeological sites and extent of the island that he argued was ultivated.[NZAA Site numbers here are from the original imperial system. These have been superseded by the Metric numbers correctly shown in figure 5.4]

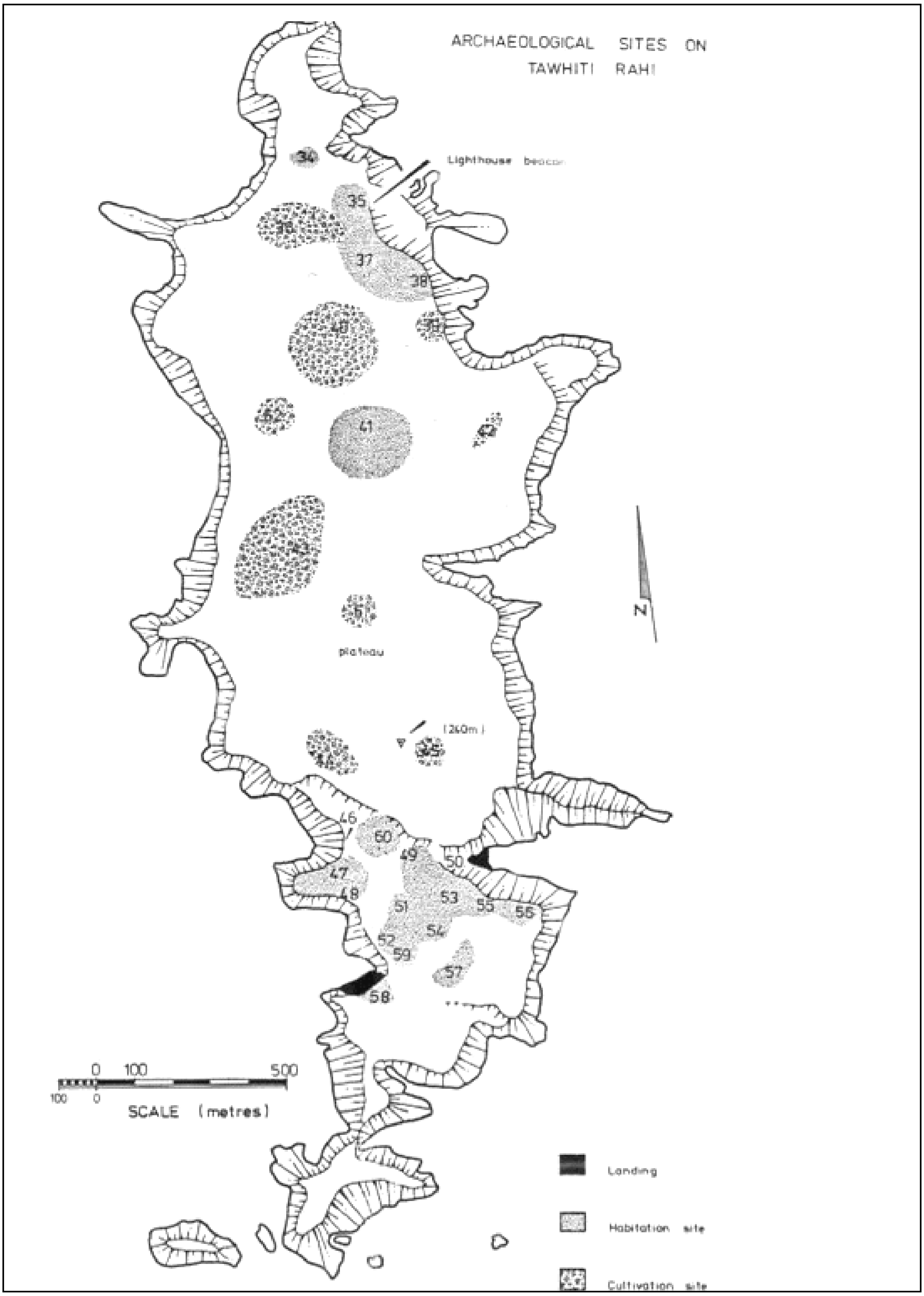


Figure 5.2 Tawhiti Rahi Island unpublished survey plan made by Lawlor in 1979, shows all recorded archaeological sites and extent of the island that he argued was not cultivated. [NZAA Site numbers here are from the original imperial system. These have been superseded by the Metric numbers correctly shown in figure 5.4]

more detailed recording and surveying were also plotted (Figure 5.3; Robinson, 2004: App 1-4). Now that the satellite navigation technology had been shown to work under dense canopy, it was just a matter of time before a complete survey of Tawhiti Rahi would occur. It is on this foundation of field data and tested methodology that the plan to comprehensively record the surface archaeological features on Tawhiti Rahi became one of the core goals of this doctoral research.

In the context of this doctoral study this chapter discusses the archaeological research – the third data source in this multi-disciplinary study. Since archaeology forms the primary focus of this thesis, the chapter takes a comprehensive look at the physical evidence of occupation left on Tawhiti Rahi. Part I gives the results of the detailed mapping of archaeological structures and artefacts across the island landscape, primarily to determine the nature of the occupation (who and why). Part II reports on a series of small and tightly focused excavations that addresses the timing of occupation and the nature of individual site function (when and why). Part III analyses the faunal and lithic artefacts that make up the islands portable material culture.

Permission to undertake this survey and excavation program was obtained from the Department of Conservation [Permit NO-16006-RES], Ngatiwai Trust Board [Letter of permission] and Heritage New Zealand Pouhere Taonga [Research excavation permit 2005-265].

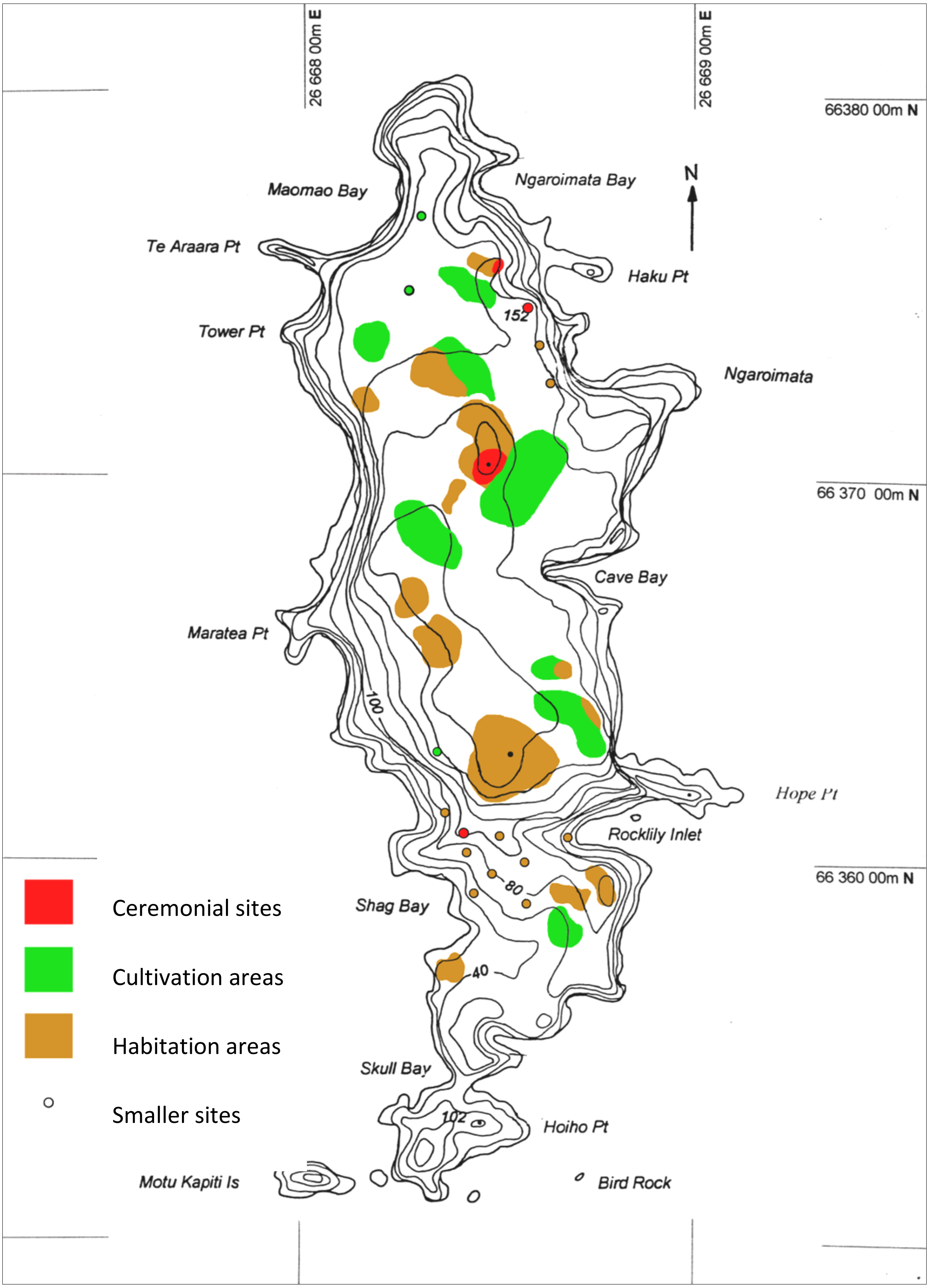


Figure 5.3 Plan of archaeological site areas on Tawhiti Rahi Island, as of 2001 (Robinson, 2004).

5.1 Part I: Archaeological Survey

How the survey was approached

Previous archaeological surveys have recorded a total of 58 sites on the Poor Knights Islands, and 25 of these are to be found on Tawhiti Rahi (Figure 5.4). Since most of the island contains archaeological stonework and earthwork features, for the most part these sites are an attempt by various archaeologists to define a discrete 'site' within what other archaeologists have referred to variously as structural components, features, compound structures, complexes and zones of stonework (Veart et al, 1984:7-14). Rather than engaging with the international debate on how sites are defined or whether they even exist at all (see Binford, 1982 and many others), it was decided that this survey would record at the more detailed feature/artifact level. At this fine scale, a survey is basically recording the presence or absence of artefacts and structural elements in a landscape. Using this approach it is possible to identify clusters of features that form 'areas' that can be defined as places that internally contain a concentration of stonework and/or earthwork features and/or artefact scatters often with no clear boundary, but which externally appear to be distinct from, and separate to other such areas.

The field survey was made using gridded tape and compass, and then each field plan was plotted using GPS technology. Isolated artefacts and features were recorded using GPS, and plotted onto exiting field plans. Features recorded on each tape and compass field plan are considered to be accurate to +-1 m. Boundary points on such plans made with the hand held GPS units were recorded with a machine error of at worst +-5 m that required a lock on at least 8 satellites. From this it is argued that the actual error on the ground never exceeded +-15 m. Therefore each 'area' of features is considered to be internally accurate to less than 1 m but which externally 'floats' within an error of +-15 m. The key advantage of using this GPS technology is that it avoids any cumulative error often associated with dead reckoning surveys. The use of differential GPS would have reduced the 'float' error down to +-1-2 m however this was not possible due to the obscuring vegetation degrading the satellite signal to a point where the Trimble differential GPS would not accept the signal. It is argued that this survey has provided data that has very good precision and reasonable accuracy, and which achieves the goals of this research. The resulting artifact data, field sketches and field maps were entered into an Arch View 9.3.1 Geographic Information System (GIS) and then digitized using a range of feature polygons and artefact point data (see method chapter 2 for

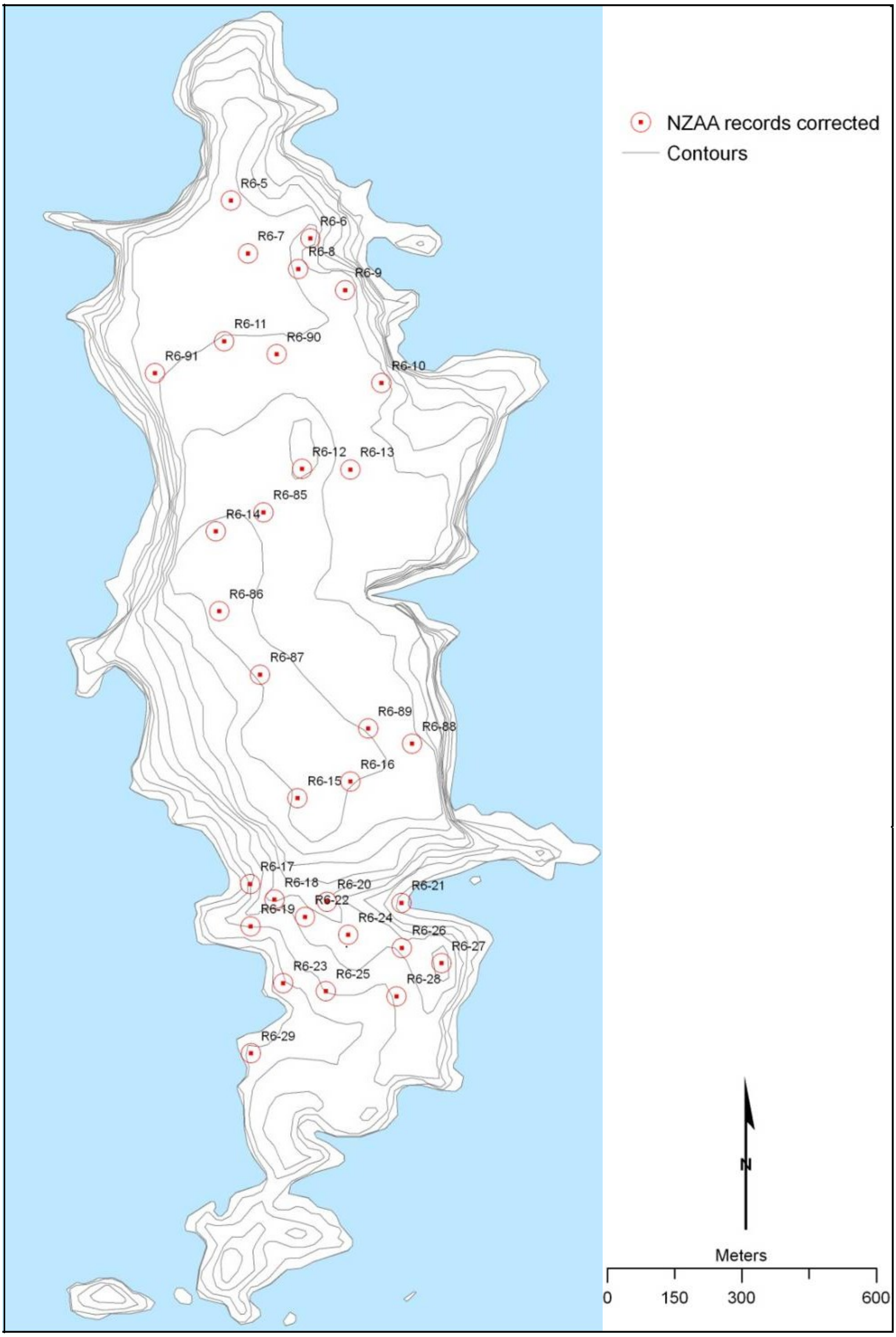


Figure 5.4 Tawhiti Rahi Island site locations: New Zealand Archaeological Association site numbers R06-5 to R06-29 were previously recorded. Sites R06-85 to R06-91 are new records generated through this current research.

details). The necessity for using GIS can be seen in Figure 5.5 where a highly complex 'jig-saw' of features is revealed in site R06-13 at the center of a large horticultural area. The resulting GISmap of these component features has captured a fine grained picture of the island's archaeological landscape that is significantly larger than was previously recognised. A total of 1681 features and 1566 artefacts were recorded (Table 5.2).

Figure 5.5 North-east garden R06-90: Shows the GIS digitising of terraces, stone rows, garden scarps and mounds, as a series of polygons on to a section of a georeferenced raster image field map.

Table 5.2 Features and artefacts recorded in the GIS program from the survey and the excavations.

Structural Features	No.	Portable Material Culture	No.
Terraces (garden)	188	Basalt (non-local)	057
Scarps (garden)	253	Chert (non-local)	013
Pits	012	White siliceous rock (local source)	151
Stone mounds	439	Obsidian (non-local)	849
Stone rows	084	Human bone	004
Earth rows	003	Dog bone	004
Stone piles	050	Fish bone	112
Stone alignments	058	Pig bone	002
Ditch/drains	005	Bird bone	004
Weirs/Dams	010	Rocky shore shellfish	145
Stone lined channels	001	Sandy shore shellfish (non-local)	048
Terraces (habitation)	439	Unidentified shellfish	012
Scarps (habitation)	082	Land snails	018
Free Standing Stone walls	003	Cultural wood	082
Retaining wall revetted	008	Ochre	029
Midden	012	Stone tools	036
Lithic work floor	017		
Cooking area	015		
Hearth	002		
TOTAL	**1681**	**(correct as of 310813)**	**1566**

How does this new data fit with our previous knowledge of the island's archaeology? Over the years, various archaeologists have attempted to understand this island landscape by dividing it up into 25 sites recorded in the NZAA site recording scheme (Figure 5.4). The current survey program confirms that most of the island's archaeology had been previously identified by first Leahy and Nichol, and later Lawlor and Hayward, however only a small percentage of the structural features andartefacts now known to exist in this landscape had been spatially recorded in any detail. This research uses the previously recorded and numbered site locations however their description and precise location have been updated to reflect the reality of what we now know is present on the ground. A small number of new sites records have had to be created for sites not previously recorded.

Only two previously recorded sites needed to be significantly relocated. Due to errors in earlier topographical maps previous surveys had incorrectly located two archaeological sites on the northern plateau. The use of GPS enabled these to be resolved by first, moving the 'Puketuaho Hill' (R06-12) site northwards by 725 m from the top of the escarpment at E2668579 N 6636344 to the highest point on the island in the middle of the northern plateau at E2668471 N6637044. Secondly, the site known as 'Quartz Hill' (R06-11) was moved northwards 260 m from the highest point on the island in the middle of the northern plateau at E2668471 N6637044 to a small knoll on the central ridge E2668316 N6637264.

What is important about the GPS and GIS based approach used in this research is the ability to identify and spatially map the 1681 stone/earthwork features and 1566 examples of portable material culture. To understand the nature of this new spatial data and how it is defined on the ground, an archaeological typology has been developed [5.1.1]. Using 12 broad island geographical zones defined by ridges, valleys escarpments and cliff tops, the archaeological features and a summary of the portable material culture are described in sections 5.1.2.1 through to 5.1.2.12. Using the typology criteria, the clusters of features that form this archaeological landscape are interpreted into areas of horticulture, habitation, specialist or ceremonial function (Section 5.1.3;see Table 5.7; figure 5.25).

Beginning in Section 5.1.1 below, the nature and extent of these geographic zones are discussed, the clusters of archaeological features and portable material culture within the zones are described, and an interpretation of their function is made.

5.1.1 Site Typology

Archaeology on Tawhiti Rahi consists of structural elements and artefact distributions. Millennia of erosion of the ancient parent volcanic rock that forms the Poor Knights has resulted in a gently rolling plateau in the north and a moderately steep landscape in the south, both of which are predominantly covered with loose rock. It is not surprising therefore that nearly all archaeological sites recorded on Tawhiti Rahi use stonework in their modification of this natural landscape, and that man-made level areas or terraces are found in a wide range of sizes all over the island. In and around these structural elements are portable material culture deposits. These include faunal material such as imported shell and local fishbone, floral material such as wood, seeds and charcoal, and lithic material. Apart from some locally sourced creamy white fine grained pyroclastic material that has been found as flakes in a few sites, the lithic material recovered from the island is all imported and includes five stone adzes, occasional water rolled basalt boulders, rare amounts of Onerahi chert and large quantities of obsidian. The obsidian is found both in localised concentrations and in wide spread scatters, and although it is generally found in association with habitation sites rather than garden sites, it can also occur in isolation away from any earth or stonework features (See Section 5.3).

Although Aorangi was not included in this survey however previous research on the poor Knights shows that it contains and broadly the same artefact and feature types (Leahy and

Nicholl, 1964; Lawlor ,1977; Hayward, 1993). Illustrations of the differing sorts of stone structures found on both Aorangi and Tawhiti Rahi were first drawn up by Leahy and Nicholls (1964:107). These were adapted by Edson (1974) and again modified by Lawlor in 1979 (Lawlor, 1988; unpublished) to produce a list ranging from eight to twelve specific structures that can be identified on the ground. The use of GIS in the present research has allowed, for the first time, the identification of a far more complex cultural landscape on Tawhiti Rahi. The feature types can occur in clusters, can individually vary quite significantly, and, perhaps most importantly, can be seen to morph into other feature types. In the east garden some stone rows start with a mound, run down slope with alternating terraces on each side, and then turn and cut across slope to become a stone faced scarp [Feature OBJID 1754]. The reality of the archaeology on the ground is that there are only a limited range of landscape modifications available to the islanders. Apart from ephemeral structures such as huts and palisades that have not survived, the 'kit' of structural tools available to the island inhabitants can be broadly defined as (i) moving earth and rock to create level surfaces i.e. terraces, (ii) removing rock to create stone free areas i.e. gardens, and (iii) bringing together earth and/or rock to create mounds, rows and scarps. Since these three methods are used in a variety of different combinations to create this complex archaeological landscape, it was necessary to develop a simpler and more flexible typology that better reflects this reality. Links to individual feature elements are referenced into the GIS program using their unique identifying number as set out here as '[Feature OBJID …]'.Links to individual items in the portable material culture also have a unique identifying number set out slightly differently as '[Point OBJID …]'.

The typology is discussed below beginning with 'Stone Structures' [5.1.1.1] followed by 'Earthwork Structures' [5.1.1.2]. 'Portable Material Culture' [5.1.1.3] is mentioned but a detailed examination follows in section 5.3.

5.1.1.1 Stone Structures Typology

These are features constructed primarily or solely from stone include mounds, piles, rows, alignments, walls, weir/dams, stone lined channels, stone hearths and zones of small surface stone and rare stone lined depressions. Definitions of the different stone structures in this

<u>Stone Mounds</u>

Mounds are constructed depositories of rock. Commonly made from a ring of large stone laid in a circle or oval within which is placed a jumble of smaller loose rocks in a soil matrix. Mounds are regular in shape being mostly circular or oval although a few form bastions with partially pointed ends. They measure from 1 to 8 m in diameter and are up to 1.5 m high. Exterior revetted stone can be as large as 80 cm while interior rocks range from five to 30 cm in size. Unlike stone piles the few mounds excavated or broken open from the actions of tree roots all appear to have an internal soil/small rock matrix under a capping of medium rock. Mounds predominantly occur within gently sloping garden areas where they often cluster directly on garden scarps (described below). However it is not uncommon to find isolated or small scatters of mounds on terraces associated with both gardens and habitation areas. Over time root action has caused most mounds to collapse or subside to varying degrees.

Mounds are the most common stone structures recorded on Tawhiti Rahi. Functionally these structures relate to prehistoric occupation through (i) clearing of surface volcanic rock from adjacent land for horticultural purposes, and (ii) the direct growing of tropical cultigens such as bottle gourds, kumara and yams on the mounds themselves (Coates, 1992; Veart et al, 1984; Sewell, 1994). The association of mounds with what is interpreted as habitation areas is unusual in the New Zealand archaeological record, however the mounds make sense if they are the results o creating level land for house sites. In Section 5.2 two mounds and two stone rows were excavated to provide dates for their construction and to better understand how they were made and used. (Plates 5.1 & 5.2).

Stone Piles

Piles are non-constructed deposits or 'dumps' of rock. In many cases piles have been added to existing outcrops of naturally occurring loose rock and as such they can range widely in size from 4 m to 12 m in diameter. One exception to this is the quarry site [Feature OBJID 2761] which is 70 m long and 35 m wide and consists of multiple natural outcrops and large scale dumping of rock. The discrete piles that are not added to naturally occurring rock are characterised by irregular shapes with extensions and curves. Some of the more extreme examples are probably the "C" and "U" shaped structures reported by previous archaeologists (Lawlor, 1988). In all piles individual rocks are medium to large in size ranging from 25 to 80 cm in length and do not vary in size from the exterior to the interior. They

Plate 5.1 East garden R06-13, stone & earth mound. [Feature OBJID562] [Findlater12040634]

Plate 5.2 East garden R06-13, stone & earth mound. [FeatureOBJID562] [Bruce 2008_DSCF4495]

also lack any binding soil matrix. The location of piles appears opportunistic in that they are found on both gentle slopes and on ridges, and in both gardens and habitation areas. The only consistent characteristic is that they are always found in association with other archaeological features. Piles are not common on Tawhiti Rahi and their function appears to relate solely to the clearing of surface volcanic rock from adjacent land for habitation and horticultural purposes. Their generic association with both gardens and habitation areas suggests that their location is more to do with the presence of naturally occurring loose rock rather than any cultural factor.

Stone Rows

Stone rows are constructed depositories of rock that form linear arrangements. They have revetted sides made from large stone two to four courses high and have an interior of loose stones. They measure from 8 to 50 m long and can be 1 to 4 m wide and 50 cm to 1 m high. Excavations (see Chapter 5 Section II) show that at least some rows of stone have an internal soil/rock matrix. Nearly all stone rows are located within the five recorded gardens. With a few important exceptions (see Garden R06-13 below), stone rows all run down slope in straight parallel lines. In the larger gardens (R06-13), stone rows are generally 50 m apart, while in smaller gardens (R06-15 and R06-90), rows are roughly 40 m apart. These 'bands' of land between stone rows have always had their loose surface rock removed and are nearly always associated with stone mounds and scarps. The most intact row yet mapped is Feature OBJID 395 found in the west garden site R06-15 (Plates 5.3& 5.4). Unlike most rows that have been variably damaged by tree roots, it appears to be well preserved with intact vertical revetted sides and internal smaller stone fill and is probably representative of what the other (partially collapsed) stone rows once looked like. The largest number of rows is located in East Garden (R06-13). Here 16 stone rows form 4 parallel lines down the gentle slope that divide the garden into 50 m wide bands while four smaller rows run across slope at the top and bottom of the slope. Together these stone rows define the perimeter/boundary of the garden [Feature OBJID 657, 672, 1487 & 2576]. The northern most of these parallel lines is formed by one stone row only [Feature OBJID 1005] that has been located on the interface between an area where all the naturally occurring loose surface volcanic rock has been removed, and an area of apparently unmodified loose surface rock to the north. Structurally it consists of a base course of two incomplete parallel lines of large (20-30 cm) rocks separated by 20 cm of loose smaller rocks. Starting at a naturally occurring boulder this row

runs for 10 m before ending (Plates 5.5 & 5.6). It appears that this feature was abandoned prior to its completion and if this interpretation is correct then it would appear that this garden was in the process of being expanded to the north when occupation ended in 1823. In design, rows are most closely related to mounds. They have revetted sides made from large stone and have an interior of loose smaller stones sometimes in a soil matrix.

Functionally, these stone rows relate to (i) clearing of surface volcanic rock from adjacent land that is then used for habitation and horticultural purposes, and (ii) structural garden boundaries that may have been surmounted with wood fences for weather protection, and (iii) forming conceptual garden boundaries that may relate to land control by particular whanau (family) or hapu (sub-tribe) groups.

Plate 5.3 West garden R06-15, stone row. [Feature OBJID395] [Bruce 2008DSCF_4346]

Plate 5.4 West garden R06-15, construction of stone row.[Feature OBJID395].
[Bruce 2008DSCF_4367]

Plate 5.5 East garden R06-13, partially completed stone row. [Feature OBJID1105]
[Bruce 2008DSCF_4500]

Plate 5.6 East garden R06-13construction of stone row. [Feature OBJID 1105] [Bruce2008_DSCF_4497]

Stone Walls

Stone walls are free standing constructed deposits. They have been identified from surface evidence in only one place on this island within site R06-13. Forming part of the northern boundary of the quarry site, this feature takes the form of a 50 cm high sub-vertical wall, sometimes three rocks high that forms a 5 m long curved section (Plate 5.7)[Feature OBJID 979]. Excavations at the top of Puketuaho Hill (R06-12)confirm that some features identified from surface evidence as 'retaining walls' are actually free standing walls that have been naturally backfilled with leaf litter (see Section 5.2). Functionally these types of structures can form conceptual boundaries associated with ceremonial significance.

Plate 5.7 Quarry site R06-13, free standing stone wall. [Feature OBJID979]. [Bruce 2008DSCF_4511]

Stone Alignments

Stone alignments are constructed deposits of single rocks laid in a linear formation that can extend for 3 to 15 m. The size of the rocks in an alignment can vary from 20 to80 cm in diameter and for the most part they form single straight lines [Feature OBJID 507](Plate 5.8). However on occasions multiple alignments can intersect as was found at the northern end of the Carver Site [Feature OBJID 139] and onthe Canoe terrace [Feature OBJID 506]. Some alignments are found on unmodified slopes and run both across and down slope while others are found on man-made terraces. The function of these structures remains unclear. Those found on terraces could relate to ephemeral structures within the terrace such as huts or minor fences. Most of those found on slopes do not have any obvious function with the exception of two large rock alignments at the base of the escarpment on the southern lowlands [Feature OBJID 509 & 510]. These could form a clear boundary line between the lowlands and the escarpment and/or could be a functional 'net' used to catch loose natural rock that might fall down the escarpments steep slope and so protect the habitation terraces below.

Plate 5.8 Canoe terrace R06-19, single stone alignment [Feature OBJID 506].
[Welch 2005 Archaeology]

Stone Hearths

Hearths are constructed features made from the placement of single rectangular rocks set into the ground to form three sides of a rectangle. Only two stone hearths have been located on Tawhiti Rahi and both occur in site R06-24 on two adjacent terraces located 20 m apart [Feature OBJID 2607 & 2611](Plate 5.9). Measuring 60 x 50 cm in size they are constructed from local silicified rhyolitic rock. The presence of fire cracking in this rock along with ash and midden inside the feature confirms their function as hearths (see Section 5.2 for further discussion).

Plate 5.9 Hearth site R06-24, Hearth 1 [Feature OBJID 2811] [Walter 2005 IMG_3861]

Stone Weirs or Dams

Weirs/dams are constructed features that are only found in the two steepest water courses identified on the island, namely Charles Stream in the southern lowlands and, to a much lesser extent, the East Stream in the East garden on the northern plateau. Consisting of a series of low walls of stone laid across the bed of the streams, they are often found in association with large ponds that appear to have been deliberately deepened (Plate 5.10). These are similar to stream bed structures noted on South-west Island in the Three Kings Island group (Maingay, 2007). Although these ponds are now in filled with silt, the function of the weir/dams would be to slow the flow of water down the stream, as well as aerate it. Benefits from this would include increasing the limited fresh water supply for drinking, as well as limiting the speed of water entering the stone lined channel adjacent to the wetland gardens in the bed of the Charles Stream (5.11).

Plate 5.10 South garden R06-28,weir/dam in the South (Charles) Stream.[Feature OBJID 320]. [Robinson IMG_20060604070017]

Stone Channel

A constructed stone lined channel extends in a straight line for 50 m along the bed of the South (Charles) Stream [Feature OBJID 321]. Built along a gently sloping area of the stream, it is associated with the adjacent line of 6 stream bed terraces where wet land gardening was assumed to have occurred (Plate 5.11). The purpose of the channel appears to be to retain the stream's water flow in a confined line along the west side of the stream bed. The function of the channel is not obvious, but along with the associated weir/dams this channel might assist in maintaining moisture levels in the adjacent gardens during the dryer parts of the year, and also help control floods during the occasional cyclonic storms.

Plate 5.11 South garden R06-28, stone lined channel in South (Charles) Stream. [Feature OBJID 321] [Robinson 2006 IMG_06040600062006.]

Small Stone Area

The zone of small stone consists of a surface formed by small (less than 8 cm in diameter) locally sourced rhyolitic rock. Two examples of this have been located on Tawhiti Rahi, one measuring 15 x 15 m is found (among but not on) the garden features of site R06-13, while the other is much larger measuring 70 x 40 m in size, and underlies the midden and lithic work floors that make up site R06-85. Since the few remnant areas of naturally occurring surface rock comes in many sizes, this 'carpet' of only small stone is unusual and due to its spatial association with archaeological features, it is assumed to be culturally associated with some specialised form of gardening.

Functionally the small rock might have been used for lithic mulching, an agricultural technique used in various places around the world including New Zealand. It is known to increase soil moisture levels by aiding infiltration and reducing evaporation, and to moderate diurnal extremes in soil temperature (Lightfoot, 1996: 221). Historically lithic mulch was consistently used to mitigate subsistence risk in dry environments but, unlike irrigated gardens, it only provided minimal gains in productivity when compared to dry land gardens (Ibid, 222). Historic accounts in New Zealand confirm such mulching was associated with early nineteenth century Māori gardening (Shortland, 1855 quoted in H.Leach, 1976:129).

5.1.1.2 Earth Structures Typology:

These features are constructed primarily or solely from earth. They include terraces, pits, earth rows, ditches/drains, and scarps. Definitions of the different earth structures in this typology are identified as follows.

Earth Terraces

Terraces are constructed earth features forming areas of flat land, created on a slope by cutting back into the slope or building up at the front with soil. These are found throughout Tawhiti Rahi on narrow ridges and broad slopes, occur in both isolated locations or in clusters, and can range in size from 2 x 3 m to 60 x 80 m. Structurally terraces can often incorporate stone in the form of non-revetted non-vertical facings that help retain the front and rear scarps. Occasional stone mounds are found on the flat surface of terraces and on their front scarps. Most of the rectangular food storage pits recorded on Tawhiti Rahi have been dug into the top level surface of terraces. It is on the top of terraces that other rare structures are found that include most stone alignments, all raised stone rims and rarest of all - stone lined depressions.

Terraces with sub-vertical front retaining walls appear at the Beacon site (R06-6) and the Puketuaho Hill site (R06-12) [Feature OBJID 1968 &1130] (Plate 5.12& 5.13). The excavations at Puketuaho show that this sub-vertical retaining wall is rather a free standing wall. What appears to have occurred is that following the island's abandonment, leaf litter and fine pohutukawa roots have collected behind this wall causing a build-up of organic material that today gives the appearance of a made terrace. In other parts of the island larger

Plate 5.12 Puketuaho site R06-12, stone wall revetment. [Feature OBJID 1130]
[Welch2005 Archaeology]

Plate 5.13 Beacon site R06-6, stone wall revetment. [Feature OBJID 1968]
[Welch 2005 Archaeology]

Plate 5.14 Quarry site R06-13, vertical retaining wall near quarry. [Feature OBJID 875]. [Robinson 2006DSCF4506]

flat areas have clearly been constructed behind retaining walls. The best example of this is found adjacent to the Quarry site in garden R06-13 [Feature OBJID 875](Plate 5.14).Examination of remnant intact areas identifies a vertical revettedwall that is square in section measuring 1 m high and 1 m wide. This has been constructed along a large saddle and then presumably back filled with soil to create the largest horticultural flat area to be found on the island [Feature OBJID 2905]. Terraces are the most common structural feature made from earth to be found on Tawhiti Rahi Island (total 627).Since they can be found on both valley slopes – where they are thought to be gardens, and ridge tops - that are thought to be habitation areas, they have been roughly divided into garden (green) and habitation (brown) categories in the GIS. It is notable that portable material culture is often found on habitation terraces but very rarely on gardening terraces.

Pits

Pits are constructed rectangular features excavated into the ground. A total of twelve rectangular pits have been recorded on Tawhiti Rahi. They occur in isolation or in clusters of three. Nine have been excavated into existing terraces and three into hill slopes adjacent to terraces. Varying in size from 2.5 x 4 m to 4 x 6 m, these pits can be found in both valley and ridge contexts and are interpreted as the remains of kumara storage structures that would once have had a wooden roof superstructure. It is suggested that the three smaller stone lined depressions recorded in R06-13 and R06-91 may have similar food storage function, perhaps for othercultigen types [Feature OBJID 997, 2178 and 2187].

Earth Rows

Earth rows are linear constructions made from soil. A total of three of these rare structural elements have been found on Tawhiti Rahi. One measuring 6 m long by 3 m wide and 1 m high [Feature OBJID1534] is found amongst a range of other stone structural elements in site R06-90, while the other two are 18 to 20 m long, 1 m wide and 50 cm high [Feature OBJID 2156 & 2191] and occur together on the end of the central ridge in site R06-11 where the natural loose stone is not present. They vary widely in shape and height and it is possible that the latter two could be field boundaries similar to the numerous stone rows and to the four ditch/drains also found in stone free environments on the adjacent northern side of the Meander Stream [Feature OBJID 2450-2453]. However at this time their function can't be determined with any certainty.

Ditch/Drain

Ditches or drains are 'dish' shaped linear depressions excavated into the ground. They run in a straight line and measure 20–40 m long, 20 cm to 50 cm wide and 5-20 cm deep. Five such ditch/drains have been recorded on Tawhiti Rahi Island. The southern most of these is a single, narrow and short depression that joins the East (Astelia) Stream at an angle between two stone weir/dams [Feature OBJID662]. This is interpreted as a drainage channel associated with wetland garden activity in the base of this stream. The other four drain/ditches are located together on the north side of the Meander Stream where they run in parallel, 8 m apart, straight down the gentle slope [Feature OBJID 2450-2453]. The fact that they don't join the stream implies that they are not drains. The fact that they occur on an area without naturally occurring loose stone suggests that they are boundaries of some sort, possibly having similar functions to the two earth rows on the south side of the stream [Feature OBJID 2156 & 2191].

Scarps

Scarps are constructed slopes made from earth and measure one to three meters vertically and three to 20 m horizontally. Always found running across slope, these features have been dug into gentle slopes that run into stream valleys and along descending ridges. They form recurring steeper sections that step down the slope. Although constructed from earth, many have been retained with stone, especially if it is locally abundant. Those in the valleys tend to cluster in groups with an internal separation of roughly 12 m and are often associated with stone mounds that are commonly built both between and on the scarp faces. Scarps on the ridges tend to be longer and larger and do not often cluster. Stone mounds do occur near them, but their association appears more random. Superficially resembling the front scarp component of terraces, scarps differ in having a gentler slope and most are stand-alone features. However on occasions a terrace may be built on a section of a scarp, or perhaps a scarp is added to either end of a terrace.

Like terraces, scarps have also been tentatively divided into habitation (dark grey) and garden (light grey) types in the GIS. These structures could have simply been places where unwanted stone from gardens or villages can be deposited, and this may well be true for the 82 habitation scarps. However the 253 garden scarps are a major engineering undertaking that are strongly associated with stone mound construction, and have resulted in significant slope reduction within identified gardens. It is argued here that such slope reduction would improve ground moisture retention. This is particularly important on an island originally littered with loose volcanic rock since empirical tests in the Negev show a 30-40% increase in surface water run-off when the naturally occurring loose rock is removed during mound construction. (Evenari et al., quoted in Lightfoot1996:212). Since some stone mounds have been shown to be well suited for the growing of some Polynesian cultigens such as hue (bottle gourd) (Coates, 1992), it is possible that some stone faced scarps had a similar function that would also take advantage of their water retention characteristics, however there is no ethnographic support for this direct garden cultivation premise.

5.1.1.3 Portable material culture typology

As is shown in table 2, portable material culture comes in a variety of forms under the sub-headings of lithic, faunal and floral material. For the purposes of section 5.1 that is focused on understanding the archaeological landscape, it is only the presence or absence of such material in and around structural features that is significant. Therefore all portable material culture is shown as undifferentiated dots on the GIS generated maps of features. A detailed analysis of this portable material culture is given in section 5.3.

5.1.2 Geographic zones

The archaeological survey of Tawhiti Rahi Island was completed in 2008. Examination of the archaeological landscape revealed through the completed GIS map showed that nearly all recorded features and portable material culture clustered together into separate areas of variable size. The gaps between these clusters lack any identifiable surface archaeology and although future excavation work may prove otherwise, they are currently interpreted as (mostly) reflecting real and actual divisions in the built landscape. To discuss this built landscape, these feature clusters have been deliberately placed into twelve named geographical zones that variously contain ridges, valleys, escarpments and cliff tops (Figure 5.6).

For the most part these zones are deliberate choices, defined by the actual presence of large archaeology clusters. However some zones are more theoretical in that they can contain two or more of the smaller clusters [e.g. the Northern Peninsula] or on occasion extend through empty areas that for various reasons are thought to not be real gaps [e.g. north Stream]. The archaeological features and a summary of the portable material culture contained in each of these zones is now described and interpreted. Where appropriate, the logic behind the shape and extent of a geographical zone is also discussed.

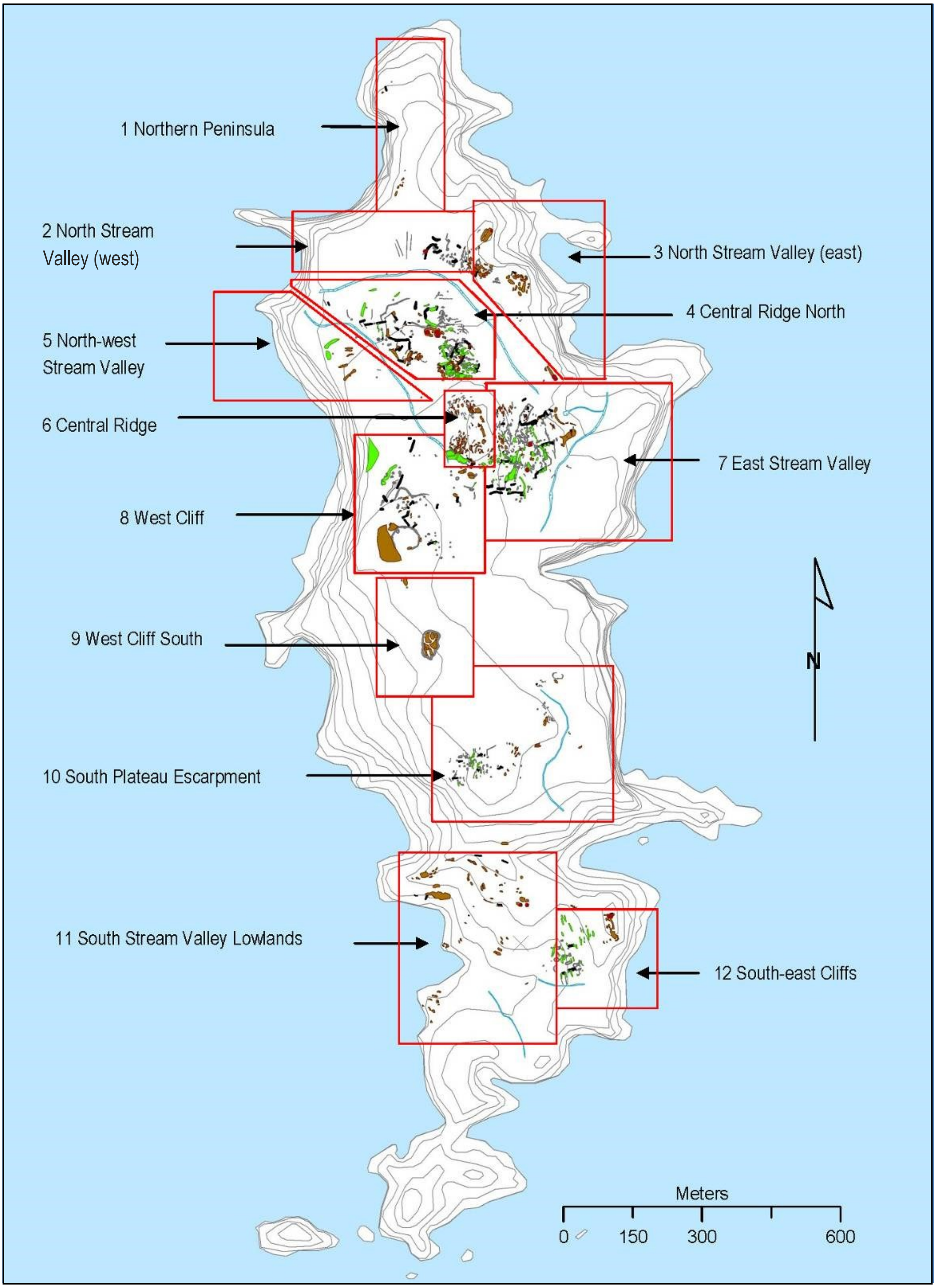


Figure 5.6 Tawhiti Rahi Island: Location and name of the 12 geographic areas discussed in section 5.1.1.

5.1.2.1 Geographic area 1 - Northern Peninsula (R06-5) Figure 5.7

Location The northern peninsula of Tawhiti Rahi starts in the south on a wide area of gently rising land on the northern side of the North (Meander) Stream. This rise levels out and abruptly narrows to form the 30-50m wide Te Paki Pt ridge that runs north at a constant altitude for 250 m before descending along a moderately steep slope for a further 200 m and then finally widening and splitting into at least two major and one minor ridge. Beyond this to the north there are vertical 60 m high cliffs that drop down to the sea. West of this point the ground drops quickly away to form a 140 m tall vertical cliff, while to the east the ground has a moderate slope for 100 m before becoming a near vertical 60 m tall cliff that again drops down to the sea.

Description Due to time constraints, Te Paki only had a cursory inspection. The low salt stunted pohutukawa trees and the extensive Buller Shear water colonies at the northern end of the point also limited the ability of the survey team to get a comprehensive picture of the archaeology present. What is clear is that there is a lithic work floor at the southern extent of the point (R06-5), made up of at least two adjacent clusters of obsidian flakes, fire cracked rock and faunal midden material that together may cover an 80 x 80 m area. 75 m to the north-west of this work floor there are five small 5-10 m long terraces and two stone piles/mounds strung along the western edge of the point. Artefacts in this area are limited to one record of a chert flake at the northern end of the terraces. 225 m north-west of these five terraces near the northern end of Te Paki point where it starts to descend and widen into subsidiary ridges, there is a single terrace cut into the rocky western cliff top on which were found two silicified rhyolitic rock artefacts of local origin. Immediately to the east of this terrace there is a small sheltered catchment that is formed between two minor ridges that gently descends to the north-west. This area may extend for 100 x 100 m but was not accessible to the survey team due to the presence of a large Buller seabird colony. When viewed from the western cliff top it is difficult to determine what if any archaeological features are present in this catchment due to thick, low growing coastal shrubs that obscure the ground in many places. Despite this handicap at least one small stone row and one stone mound were noted on the western edge of a Buller colony.

Interpretation Site R06-5 contains a lithic work floor at the southern end of this geographic zone however the remaining features on Te Paki Point are not so easily interpreted. The five terraces to the north-west appear too small to be associated

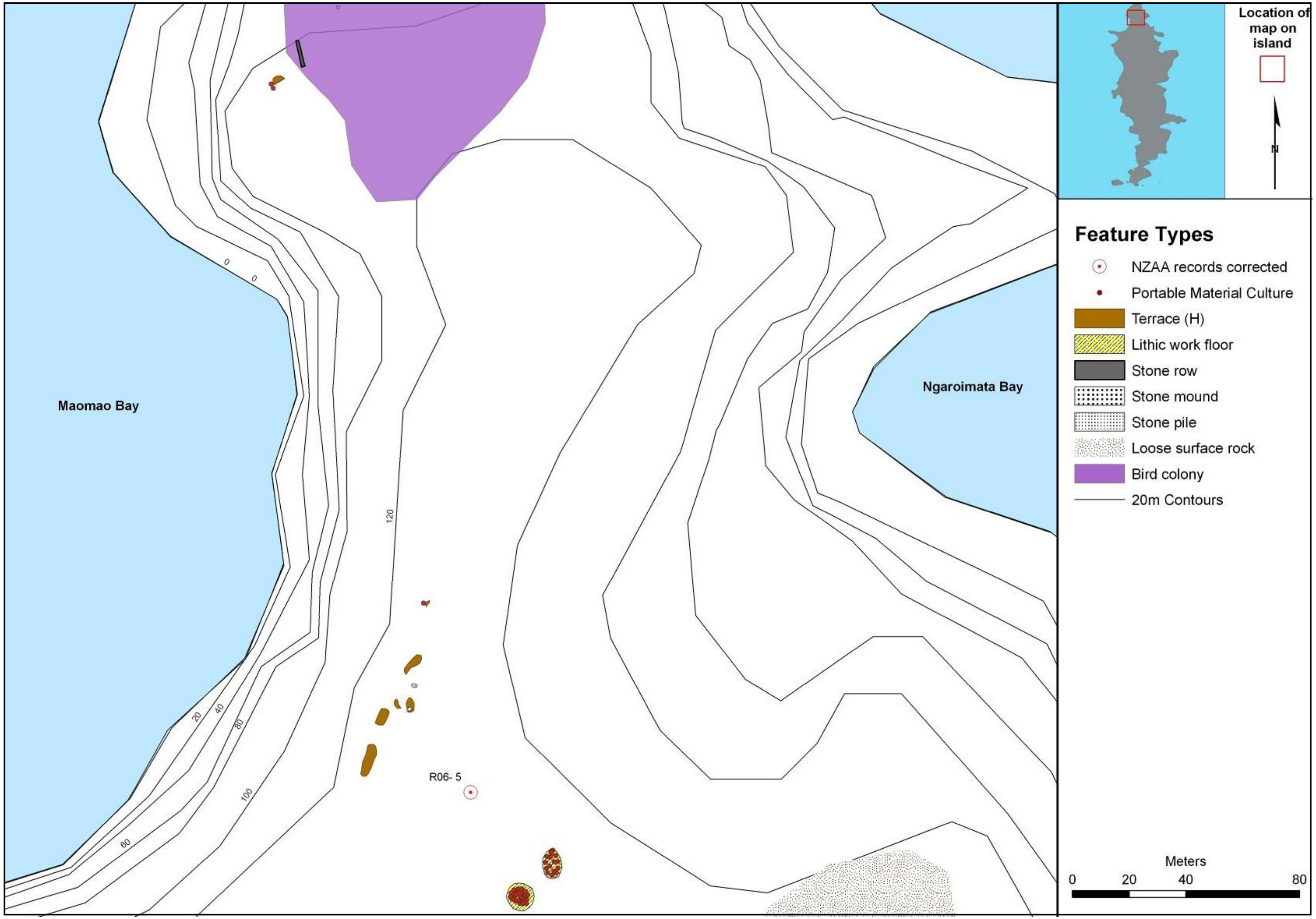


Figure 5.7 Geographic area 1 - Northern Peninsula (R06-5)

with horticulture. It is possible that they were used as a processing site for seasonal mutton-bird collecting from the adjacent Buller Shearwater colony. Alternately they could be a strategic lookout site, since people on them would have had clear view for 225 degrees from the east through to the south-west. Currently the area is classified as a habitation area, however the lack of opportunity to comprehensively examine the area and determine if artefacts or midden are present means this is only an interim interpretation.

The terrace and small stone row feature recorded on the northern slopes at the end of Te Paki point are currently included within the extent of site R06-5. This sheltered area between two north running spurs could have been a gardening area, however until a more detailed inspection of the area occurs no definitive interpretation of function can be made.

5.1.2.2 Geographic area 2 - North Stream Valley West (R06-7) Figure 5.8

<u>Location</u> Situated on the northern end of the island just south of Te Paki Point (R06-5), west of R06-8, east of the western cliffs and to the north of the North (Meander) Stream, this cluster of features is located within a 180 m x 80 m block on the gentle south dropping slope that forms the north side of the broad North (Meander) Stream catchment.

<u>Description</u> Features identified within this cluster include 31 stone mounds, one stone pile, six stone rows, occasional stone faced garden scarps and one food storage pit. In addition four down slope drains in two adjacent parallel clusters are located at the western margins of this archaeological area in a stone free area (R06-7). 40 m to the north this feature cluster is bordered by the lithic work floor of site R06-5, while to the east it adjoins with the habitation site of R06-8.

<u>Interpretation</u> This cluster of archaeological features is considered to be primarily focused on the gardening of kumara and/or bottle gourd. This is argued from the fact that (i) the features are located in the valley catchment, (ii) the features present are dominated by stone mounds and garden scarps, (iii) the cluster as a whole is (partially) bounded by stone rows and that (iv) few artefacts and no terracing was found here. The presence of a rare food storage pit in the midst of a cluster of stone rows may support the idea that gardens must be near-by.

Although the north side of the North River catchment extends westwards for 360 m to the western cliffs, the archaeological features are only found to the east where loose volcanic rock is present. It is likely that the area to the west along the northern side of this stream catchment

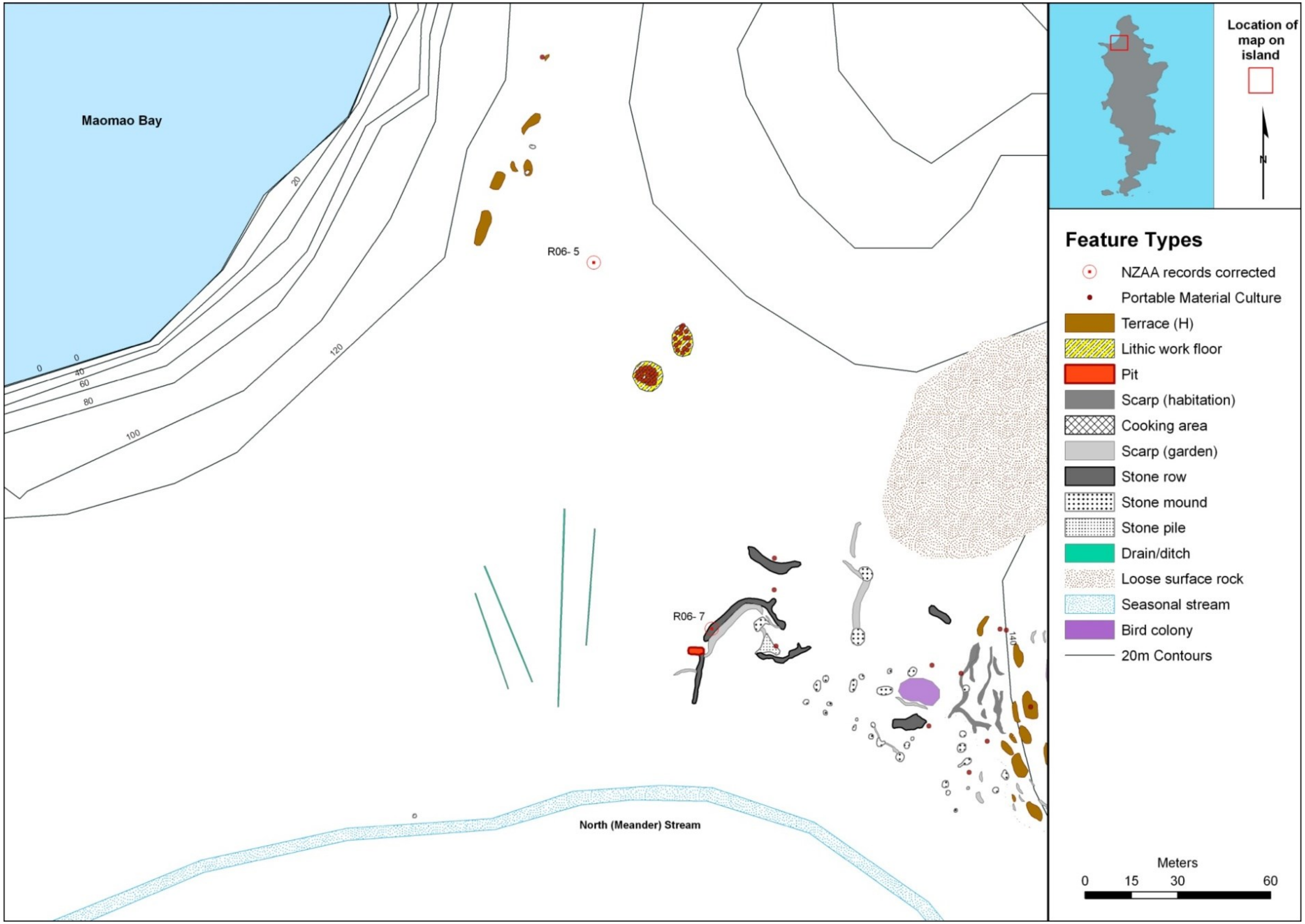


Figure 5.8 Geographic area 2 - North Stream Valley West (R06-7)

was also used, but it's unique (for this island) lack of surface rock meant that there are few Māori landscape adaptations available that would leave behind an archaeologically identifiable 'foot print'. One such rare adaptation is drain or ditch lines. Here four parallel drain or ditch lines occur at the western end of this feature cluster where the loose rock ceases. They run down slope for about 100 m and are found roughly 15 m apart. In the context of this islands archaeology it is probable that, like the stone rows in other gardens on Tawhiti Rahi, these drains defined social/family boundaries. If the interpretation is correct that the East garden was in the process of being extended to the north at the time the island was abandoned [see 5.1.2.7 East River Valley], then it is also possible that these drain lines might reflect the start of a similar garden expansion into the western part of the North River Valley.

It is interesting to note that all the features are located on the upper slopes of the valley and that their southern extent consistently stops approximately 30 m upslope from the bed of the water way. This pattern is also evident on the southern side of the catchment and has also been noted in places along the North-west (Buller) stream and between the East garden (R06-13) and the western side of the East Stream. This lack of any loose stone based archaeological features may be due to rocks near the stream bed being buried by long term soil movement down slope, or they may have been deliberately removed by people, as appears to have occurred on the western side of Puketuaho hill (R06-12) where the knoll slope meets the river flats. Whether the stone free status is a result of natural or human actions, this zone is clearly the most fertile and best sheltered area within the North Stream West garden system – albeit one which would have been subject to rare inundations. As such it is highly likely that this gently sloping sheltered area adjacent to the stream, did not require any earthwork modifications for it to have been gardened with crops that thrive on a higher water table such as taro or yam.

5.1.2.3 Geographic area 3 - North Stream Valley East (R06-6,8,9,&10), Figure5.9

<u>Location R06-6, 8, 9 & 10</u> Situated on the north-east side of the island, this cluster of features is located on top of, and on the western side of, a 400 m long winding section of raised cliff top ridge. The features extend south-south-east from the beacon light in the north to an isolated food storage pit and terrace in the south. To the north-east there are 100 m high vertical cliffs that drop vertically to the sea. To the south-west a gentle to moderate slope drops down into the headwaters and upper reaches of the North (Meander) Stream valley. The ground drops steeply away along thecoast north of the beacon (R06-6) andsouthofthefood storage site(R06-10).

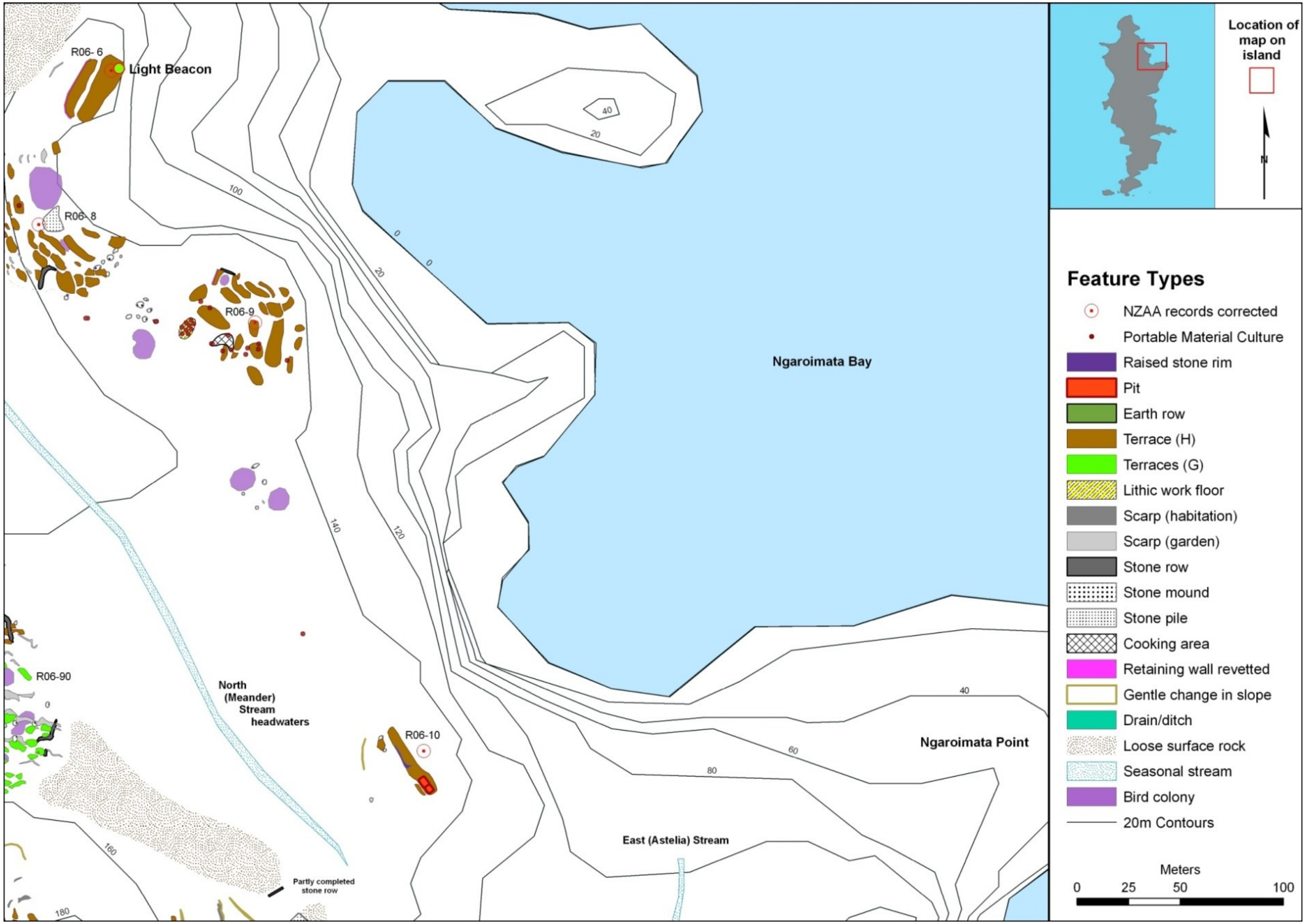


Figure 5.9 Geographic area 3 - North Stream Valley East (R06-6, 8, 9, & 10).

Description R06-6, 8, 9 & 10 Archaeological features are scattered along the full 400 m length of this narrow cliff top ridge and up to 100 m to the west down into the stream valley. To the north, the natural protection formed by the cliff on the east and north sides was supplemented by the prehistoric construction of a 60 m long curving sub-vertical retaining wall on the western and southern sides of the beacon (R06-6). In the late 1960s a light beacon was built on, and gave its name to this point. Although the retaining wall was not modified by this historic construction, the area inside the wall has been excavated to create a level surface on which the beacon light and helipad was constructed. Examination of the 1960 aerials hints that two prehistoric terraces may have been modified to create a level foundation for this beacon. No artefacts or faunal material were noted above the retaining wall.

Below this wall to the south and east, there are two clusters of small terraces and some minor areas of stone rows and mounds (R06-8, R06-9). 120 m south-east of the last cluster of five stone mounds the final feature is a group of three terraces. The longer of these terraces extends for 40 m along the ridge top and has a two adjacent food storage pits cut into its southern end (R06-10).

Interpretation Beacon R06-6 This site is located on one of three high points on the island that are argued to be of ceremonial significance (R06-06, R06-12 and R06-18). All three of these sites lack faunal remains, and lithic artefacts are rare if not absent. All three of the sites contain rare lateral retaining walls (R06-6, R06-12 and R06-18), Two of the three high points contain burials (R06-12, R06-18), and a different two contain rare terraces with raised rims (R06-12, R06-18). Physical boundaries between the tapu (sacred) areas on these high points and the noa (profane) areas of habitation and horticulture below include natural cliffs that, where needed, have been augmented by man-made features that include free standing sub-vertical walls (R06-6, R06-12) and a ditch/terrace cut into a ridge (R06-18). From this it is argued that all three are urupa (burial) areas.

Interpretation R06-8, R06-9 These two medium sized clusters of features (R06-8 &9) are located on the cliff ridge top and the adjacent upper northern slopes of the North River Valley. Between them they contain 45 terraces and 17 small mounds, as well as faunal remains and a scatter of lithic material that includes many obsidian flakes and, at site R06-9, an adze. As such these are interpreted as being habitation areas. In contrast, the two smaller groupings of stone mounds on the upper slopes of the North River Valley catchment located between R06-8 and R06-9, and south of R06-9, and the isolated stone mound adjacent to R06-10, lack any faunal or lithic material. These then are considered to be just the visible components of a horticultural area located on a narrow 300 m long strip between the cliff top to the east and the base of the North river valley to the west.

As has been discussed earlier, there is a consistent pattern in the North (Meander) Stream where garden features are located on the upper slopes on both sides of the valley and that depending on the degree of slope present, their down-slope extent consistently stops approximately 30-50 m upslope from the bed of the water way. These upper well drained slopes are well suited to traditional kumara cultivation. The lower slopes and the area around the stream bed itself are the most fertile, have the highest ground water content and are the best sheltered zone within the North Stream Valley East catchment area. They would however be subject to rare flood inundations. As such, they are highly likely to have been gardened with different crops such as taro or yam that thrive on a higher water table.

Interpretation R06-10 This cliff ridge top terrace and food storage pit site lacks any surface faunal or lithic material. Its location in a well-drained area on the cliff top ridge suggests that the pit was used to store cultigens such as kumara. If correct it is likely that the large terrace was used to process harvested kumara from the adjacent horticultural area discussed above. This leads to the interpretation that this is a specialist food storage site.

5.1.2.4 Geographic area 4 - Central Ridge North (R06-11, R06-90), Figure 5.10

Location R06-11 This site is located on the central north running ridge that separates the western and northern valley systems on the high plateau at the northern end of the island. It is one in a sequence of sites on top of this ridge, being one kilometer north of the larger Puketuaho Hill (R06-12). It is also immediately west of the extensive stonework (R06-90) on the moderate eastern slopes of this central ridge that forms the south-western side of the North (Meander) Stream catchment. Site R06-11 extends for 160 m N-S and 60 to 120 m E-W along this ridge and reportedly contains the only large grove of the Northern Rata on the island (NZAA site record R06-11). From the south this archaeological area starts out on the ridge top at the top of a small 10 m high scarp situated at the end of a moderately narrow and level section of ridge. Moving north-west down this ridge top scarp, this ridge abruptly becomes much wider and lower and curves to the west. The gently sloping sides of this central ridge now fall away to the south to join the North-west Buller Stream catchment and to the north to the join the North (Meander) Stream.

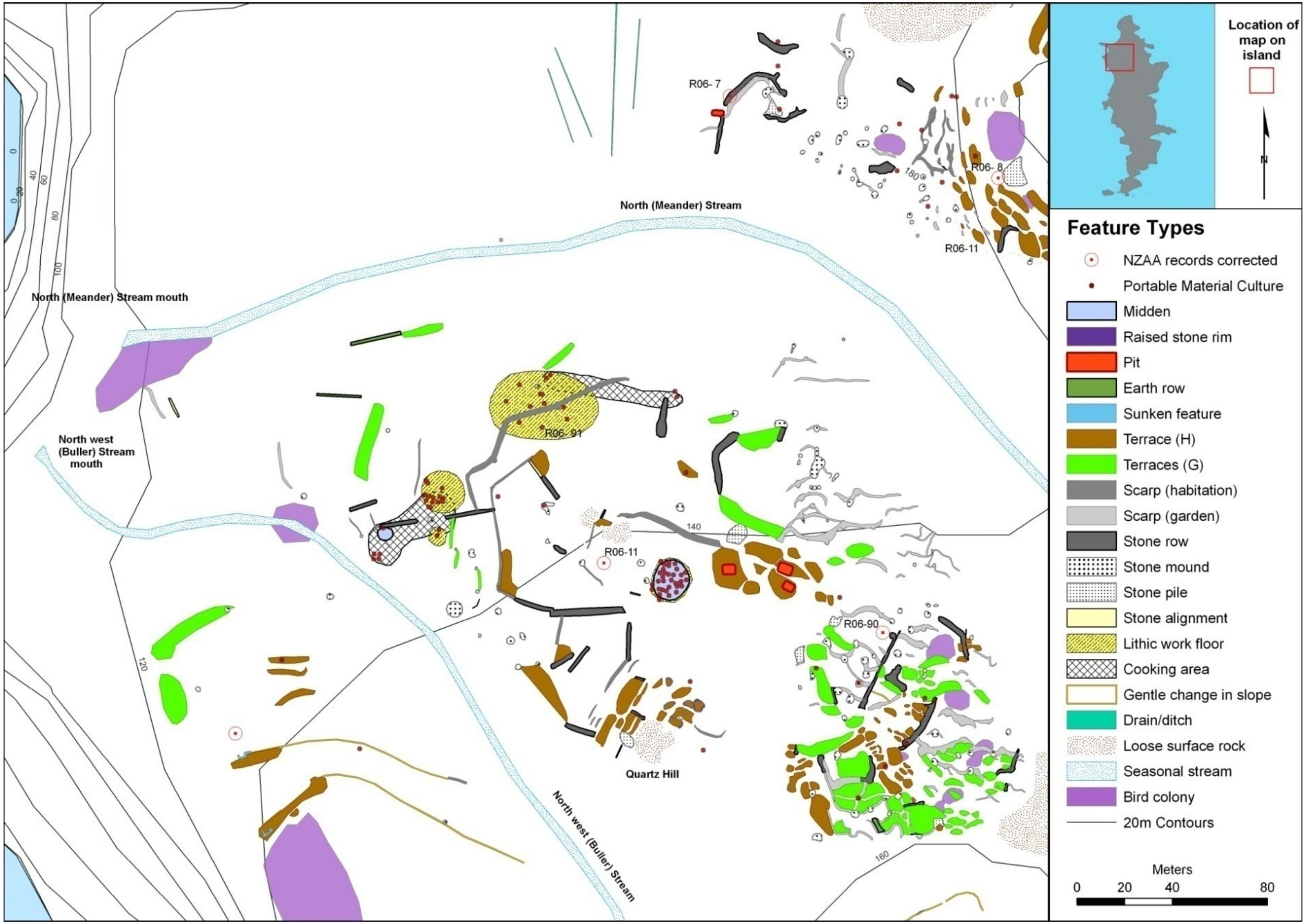


Figure 5.10 Geographic area 4 - Central Ridge North (R06-11, R06-90).

Description R06-11 The 10 m scarp described above is small, measuring only 50 x 50 m, and contains a cluster of 12 small terraces (4-10 m long), some with unusual stone walls and three with raised stone rims. No surface deposits of midden or lithic material were identified here. The name 'Quartz Hill' that is applied to this scarp appears to be a recent name that derives from the significant amount of 'white' or quartz like silicified volcanic rock that is visible among the predominantly darker coloured rhyolitic rock that has been used here to build stone structures such as stone facings, mounds and rows.

Most of the archaeological features to be found within site R06-11are located immediately north of Quartz Hill where the ridge is broad and low with gently sloping sides and covers an area of 180 m west-east and 150 m north-south. The broad top of this wide ridge encompasses three lithic work floors, one cooking and one midden area, two zones of loose stone and a series of stone row boundaries. Significant quantities of portable material culture are present in the form of lithics (mostly obsidian and occasional fire cracked rock) and faunal material (mostly rocky and sandy shore shell fish). Nearly all are found clustered within the lithic work floors or cooking areas. Like other obsidian clusters that occur on this ridge to the north of Puketuaho, this area contains small groves of Karaka trees that were a recognised food resource.

The gentle slopes on the south side of the ridge and on the ridge top between the converging Meander and Buller water ways contain 16 stone mounds as well as eight terraces – four that are long and wide and three more moderate in length but very narrow. Apart from material found in one of the discrete cooking areas [Feature ID 2771] that extends down the slope towards the Buller Stream, these slopes contain no further lithic and midden material.

Interpretation R06-11 The archaeology found on the ridge top north of Quartz Hill contains large level areas with few structures apart from occasional stone rows and scattered stone scarps. Discrete areas have been identified here, some of which contain lithic material while others contain faunal remains, charcoal stained soil and fire cracked rock. The presence of such lithic work floors, karaka trees and cooking areas on the top of this ridge implies that this is in general a habitation area with associated smaller specialisation areas that focused on food preparation and tool manufacture. The gentle slope on the western side of this ridge containing a few large terraces, a scatter of stone mounds and very little portable material culture is interpreted as being a cultivation area. Discrete areas of small surface rock are visible behind Quartz Hill and also to the north adjacent to the above lithic zones. These may be remnant areas of unmodified natural land however their location within a highly human modified area suggests that they were deliberately constructed. Their actual function therefore is not apparent from this surface survey.

Among the 15 terraces built on and around Quartz Hill itself there are three small terraces with raised stone rims similar to that found at sites R06-12 and R06-18, and like sites R06-6, 12 and 18 it similarly is not associated with faunal or lithic material. However unlike sites R06-6, 12 and 18 it is not considered to be of ceremonial significance but rather is thought to be a habitation area. This interpretation is based on the following three points: First, that a series of test pits uncovered charcoal and charcoal stained soil on the upper terraces, a characteristic of cooking activity (see chapter 5 Section III for details). Second, that although called a 'hill', Quartz Hill actually lacks any high point that appears to be a conceptual pre-requisite for Māori burial sites late in prehistory, and thirdly, unlike the ceremonial sites found at Puketuaho (R06-12) and the Beacon terrace (R06-6),there is no defining wall to form a physical boundary between a tapu (sacred) precinct on the ridge and the noa (profane) areas of habitation and horticulture that merge with Quartz Hill to the north, west and east.

<u>Location R06-90</u> Found on the high plateau at the northern end of the island, this site is located on the eastern slopes of the central north running ridge that separates western and northern valley systems (Buller Stream and the Meander River respectively). It is one in a sequence of sites located on the top and sides of this ridge, being one kilometer north of the larger Puketuaho Hill (R06-12) and immediately east of and adjacent to the large site R06-11 that is located on top of this central ridge. It extends for 100 m N-S and 220 m E-W and runs from the ridge tops eastern edge eastwards down the moderate to gentle slope on the side of the ridge that also forms the western side of the North (Meander) Stream catchment area.

<u>Description R06-90</u> A cluster of three food storage pits and 10 associated terraces extends for 55 x 25 m along the eastern edge of the ridge top. Adjacent to this to the east is a 200 m (N-S) by 80 m (W-E) area of moderate to gentle slope that drops north-east towards the Meander River. In this area bounded or divided up by 13 stone rows, are found a mostly clustered distribution of 47 medium to large garden terraces, 79 stone mounds, 67 garden scarps, four stone alignments and five stone piles. In addition, a total of 42 medium to small habitation terraces are found primarily clustered in two groups, one at the eastern edge of the ridge top and one half way down the slope towards the Meander River. The only examples of portable material culture found within this large area of archaeological features are six isolated obsidian flakes.

<u>Interpretation R06-90</u> The archaeology found on this eastern edge of this ridge top and which extends broadly east down the valley sides towards the Meander River, is primarily

a garden area that is generally referred to as the 'Northern Garden'. One habitation area and one specialist food storage area are located on the uphill western edge of this Northern Garden while one further habitation area is situated right in the middle of the garden.

5.1.2.5 Geographic area 5 - North-west (Buller) Stream Valley (R06-91), Fig 5.11

The North-west (Buller) Stream Valley is located on the northern plateau and is situated between the central ridge top to the east and the western cliff ridge to the west. The stream headwaters start at a point west of the central ridge knoll (R06-12) and north of site R06-85 and run through this gently sloping valley for over 500 m in a north-westerly direction before exiting in a seasonal waterfall over the western cliffs. The eastern side of this catchment is part of the central ridge; the archaeology found on the north-east side of the stream bed as described in geographic area 4. Features at the southern end of the ridge (R06-14 north) are described in geographic area 6. The archaeology west of the stream bed (R06-91) is mostly found on the western cliff top ridge and is discussed here as geographic area 5.

<u>Location R06-91</u> Located at the mid-point of Tawhiti Rahi Island at the northern end of the ridge that forms the western cliff top, this ridge is broad and wide and descends gently to the north. It is situated just to the east of the vertical western cliff that drops to the sea and west of the catchment containing the North-west (Buller) Stream. It is bounded to the north by the point where the descending ridge meets the mouth of the Buller stream that drains over the cliff edge and to the south by the terrace and stone row features of R06-14 [north] that form the northern extent of the 'Western Cliff Central' geographic cluster 6.

<u>Description</u> This section of the western ridge extends for a length of 250 m on a NW to SE bearing and has a usable width of 120 m that includes the ridge top, the moderate slopes that drop east to the Buller Stream and the moderate upper slopes between the top of the vertical western cliff and the western cliff ridge top. Within this area there are only a small number of confirmed features. These include five habitation terraces, two garden terraces and four stone mounds. The upper two habitation terraces each have a single sunken stone lined feature measuring 3 x 5 m on their western quarter. Stone faced scarps extend on a constant contour east and south from two of the central ridge top terraces. Similar but very vague scarps (too indistinct to be recorded) are possibly present in and around the remaining terraces. The 150 m long area between these confirmed terraces and site R06-14 (north) to the south hints at even more vague features along the top and eastern sides of this ridge. The only artefact located was a single obsidian flake reported on the northern most habitation terrace.

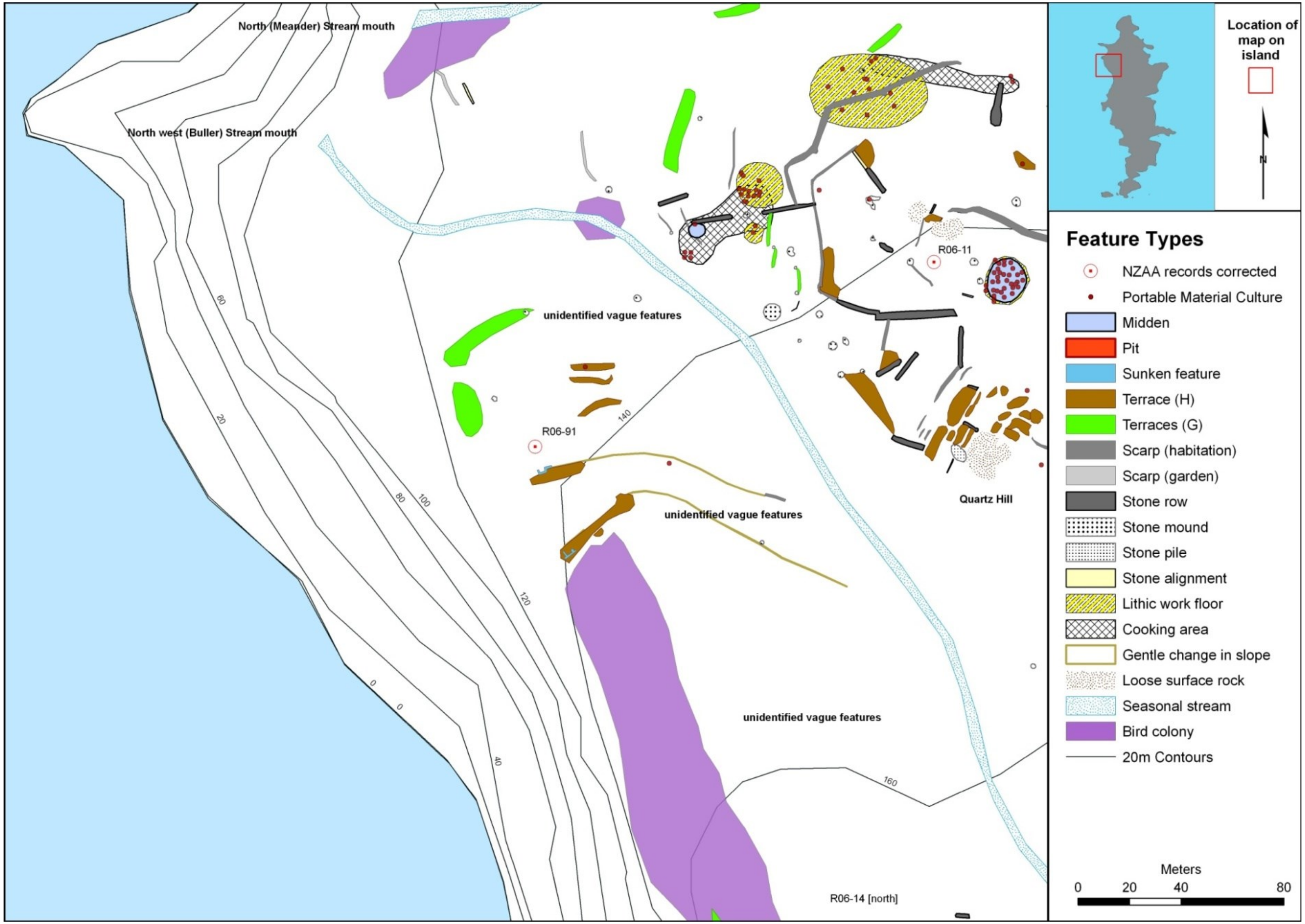


Figure 5.11 Geographic area 5 - North-west (Buller) Stream Valley (R06-91).

Interpretation The lower sides and floor of this North-east (Buller) Stream contain only small pockets of garden features to the north-east that form part of site R06-11 (described in geographic area 4) and to the south east that form part of site R06-12 (described in geographic area 6). Considering the archaeology found in the other valleys on the northern plateau, it is highly likely that much of the valley floor and lower sides were gardened. However the lack of any confirmed features beyond that described above means that this interpretation of function can't be confirmed by this survey.

It is fair to say that the visible archaeological landscape here on the western ridge are the worst preserved of any found on the island. The dominance of large terraces, the extensive area of very vague features and the lack of artefacts hint that this is an old and highly modified horticultural area. If the existing extensive sea bird colony was present during the human history of the island then an alternate hypothesis is that features in this area - like the small sunken stone features on two terraces [Feature OBJID 2178 & 2187] - may instead have been associated in some way with the harvesting and processing of juvenile Buller Shearwater as mutton-birds. Clearly the function of this western ridge area cannot be determined from an analysis of the few surviving surface features and further research and investigation is required.

5.1.2.6 Geographic area 6 - Central Ridge (R06-12), Figures 5.12, 5.13 &5.14

Location On the plateau that forms the northern two thirds of Tawhiti Rahi Island there is a distinctive broad central ridge that divides the north-western, eastern and northern river valleys. This central ridge forms a giant descending arc. Branching initially off from the high western cliff ridge, it gently descends first northward and then sweeps around to the north-west before finally turning west and ending again at the western cliff between the mouths of the North-western (Buller) Stream and the North (Meander) Stream. Situated on the mid-point of the curving central ridge there abruptly appears a steep rise that forms the south side of a large roughly 'kidney' shaped natural knoll that is both the geographical center of the plateau and the highest point on the island. The eastern side of the knoll has a natural boundary in the form of a 10-20 m high vertical cliff that runs along the 180 m contour interval. The southern and western sides have moderate to steep slopes while the northern flank has a moderate to gentle slope that finally merges again with the gently descending central ridge (Figure 5.12).

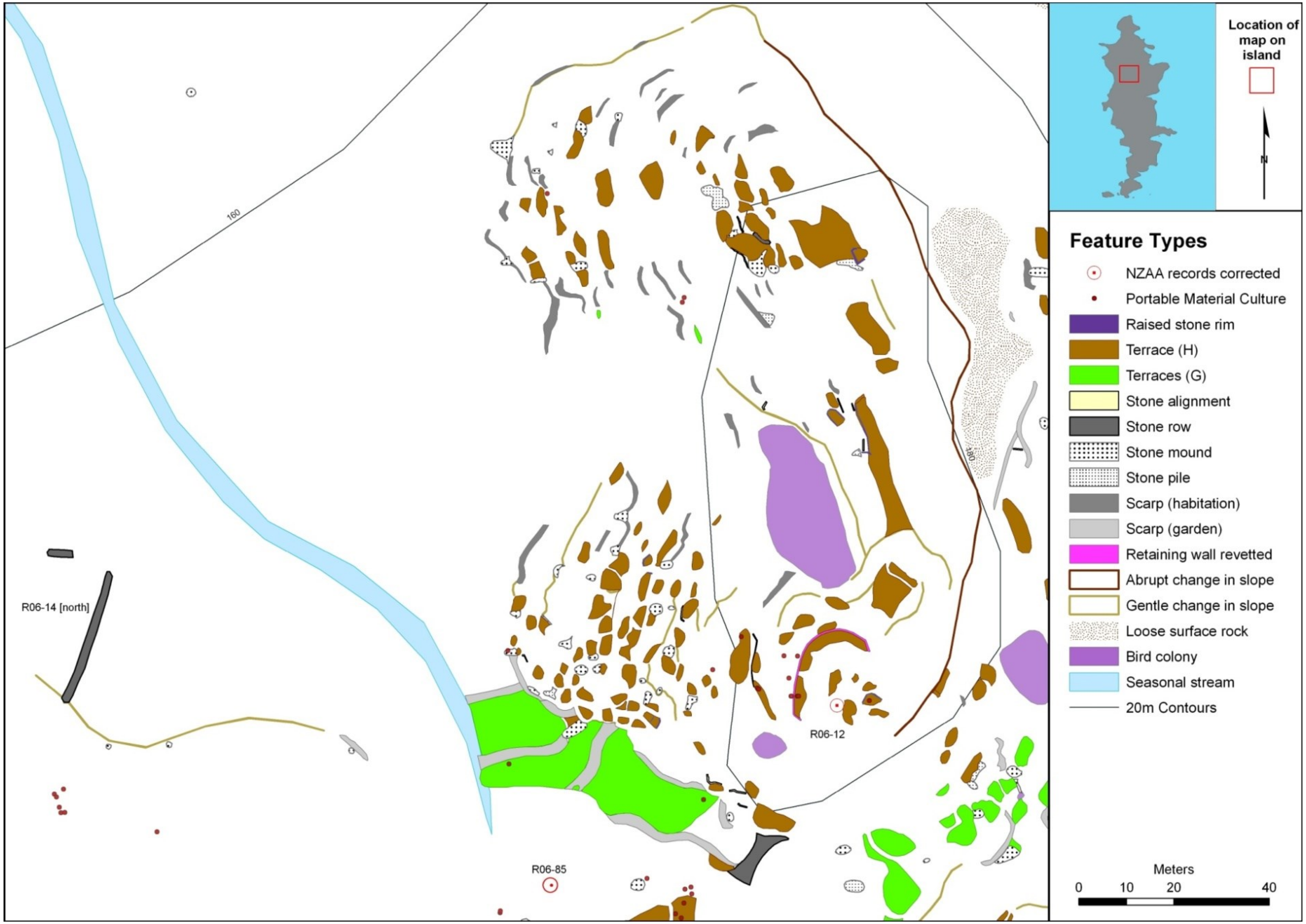


Figure 5.12 Geographic area 6 - Central Ridge (R06-12).

Description The archaeological features built on and around this large knoll (site R06/12) form the most complex site present on Tawhiti Rahi Island. Named 'Puketuaho Hill' by Pickmere in the 1920s (see Chapter 3 for further discussion on names), the archaeological features extend for over 250 m north-south and 180 m east-west and is dominated by a complex of over 100 terraces that cluster especially on the top, the north-western slopes and the south-western slopes of the knoll. These terraces abruptly stop on the edge of the stone free valley floor to the west (Buller Stream). The features at the southern end of the knoll merge more gently with the extensive earth and stone features associated with site R06-13 and the East (Astelia) Stream catchment (Figure 5.13).

This kidney shaped knoll is delineated by steep natural cliffs to the south-east, east and north-east and its highest point is at the southern end. An area of 30 x 30 m around this high point is bounded by natural cliffs to the south and east and by a 40 m long curving sub-vertical retaining wall to the north and west (Figure 5.14). This high point area has exposed rhyolitic rock in places and contains mostly small terraces some with raised stone rims but lacks any midden or lithic material. The terraces below this sub-vertical retaining wall extend westwards down slope to the valley floor of the North-west (Buller) Stream. They are small to medium in size (2-10 m) and have sloping non-revetted stone facings. It is interesting that the 20 stone mounds found amongst these terraces are all clustered on the moderately sloping lower slopes while the occasional shellfish and flake tools are clustered on the upper steeper slopes immediately below the 40 m retaining wall. The boundary between the complex stone structures on the western knoll slopes and the completely stone free valley floor is abrupt and is clearly man made. The valley floor itself has been modified into three large earth terraces with low earth scarps.

North of the 40 m retaining wall, the knoll forms a narrow near level saddle containing a series of large ridge top terraces. North of this the knoll widens and descends in an arc from the west to the north and contains another cluster of terraces, mounds, occasional stone piles and numerous stone faced scarps that also stop abruptly at the valley floor. The only portable material culture found here was one sample of ochre and one example of locally sourced silicified rock.

Interpretation The 100 medium to small terraces along the ridge and on the lower western and eastern slopes of Puketuaho, along with the presence of occasional lithic and faunal artefacts, supports the interpretation that that this is a village site and therefore it i categorised as a habitation area. The large earth terraces in the moderate slopes of the North-west (Buller) Stream headwaters are clearly horticultural in purpose and probably are part of extensivegardening along the floor and slopes of the Buller River that extends at least as far as

Figure 5.13 Puketuaho Hill (R06-12): Detailed drawing of archaeological features.

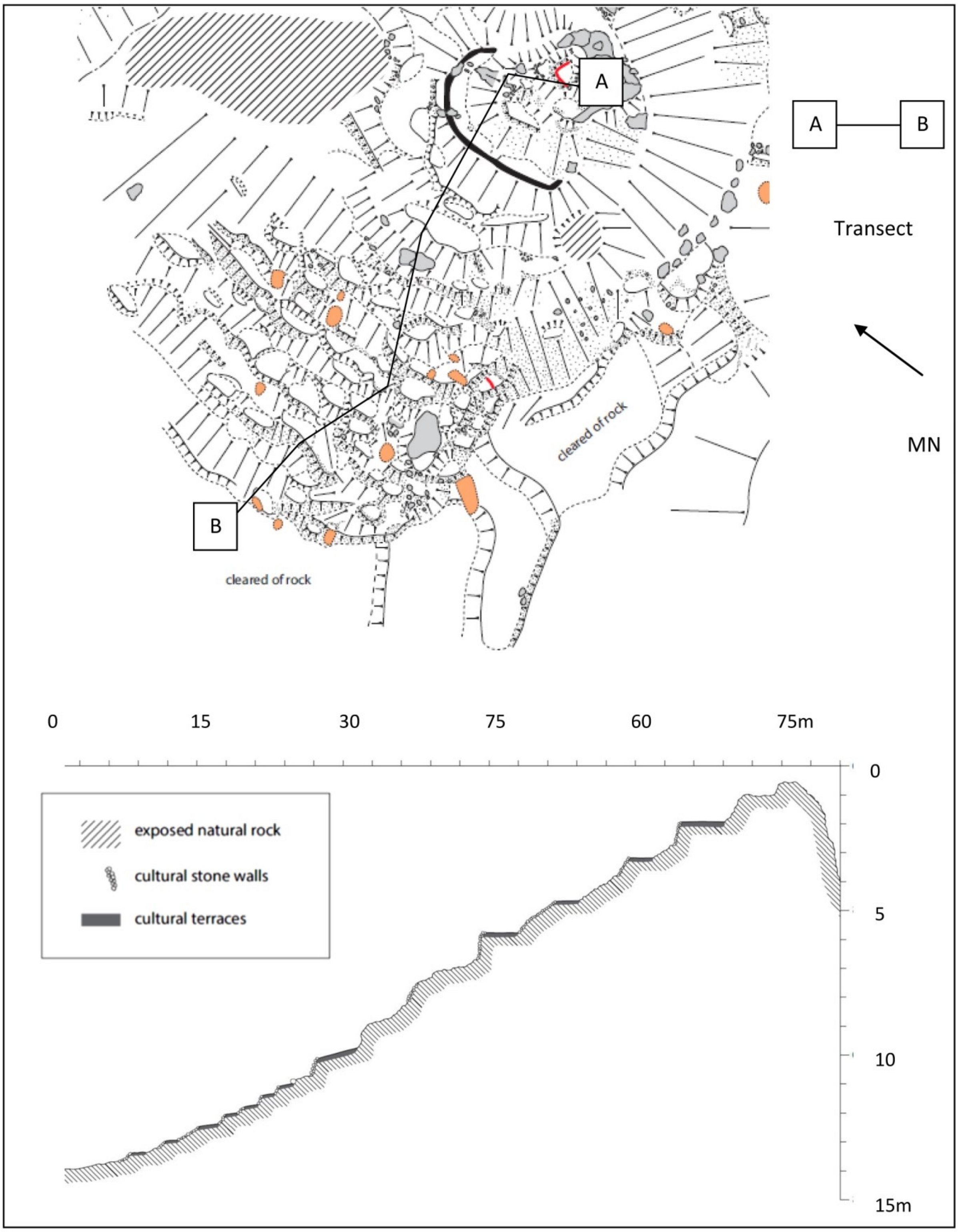


Figure 5.14 Puketuaho Hill (R06-12): Transect from the top of Puketuahohigh point down ‘A’ and running west down to theBuller Stream valley floor at low point ‘B’. The vertical height is exaggerated.

the stone rows of site R06-14 (north) on the western side of the catchment.

Like the Meander Stream to the north and east, the floor of the Buller Stream to the west is devoid of features along a 30-50 m wide band. It is argued that this highly fertile and sheltered area would have been subject to rare inundations. Since the better drained headwaters and upper slopes of the river show structural evidence of gardening presumably associated with kumara cultivation, it is highly likely that this gently sloping sheltered area down-stream from the three large earth terraces did not require any earthwork modifications for it to have been gardened. This would have suited crops that thrive in moisture rich environments such as taro or yam.

The top part of Puketuaho Hill (R06-12) is the highest point on Tawhiti Rahi Island and has a commanding position overlooking all of the plateau that forms the bulk of the island and in particular over the three river valleys with their concentration of gardens and village sites. Along with site R06-6 (Beacon site) on the north-eastern cliff edge and the Citadel site (R06-18) overlooking Camp Bay on the south-west coast, all three sites have been built on visually distinctive high points that are argued here to be of ceremonial significance. Survey evidence in support of this hypothesis include the lack of any faunal material on any of the three, the presence of deliberately buried or deposited human skeletal remains on one site (R06-18) and the appearance of rare features such as sub-vertical retaining walls (R06-6, 12 & 18) and raised stone rim terraces (R06-12 & 18). Together these suggest that all three sites are urupa (burial) sites where the rare revetted walls provide a formal and a conceptual boundary between the tapu (sacred) area of the hill top above and the noa (profane) area of the habitation terraces below. To test this idea a small excavation was conducted in the area above the sub-vertical retaining wall. The results from this investigation are set out in Section II of this chapter.

5.1.2.7 Geographic area 7 - East (Astelia) Stream Valley (R06-13), Figs 5.15 – 5.17

<u>Location</u> Located on the northern plateau east of the central ridge, west of the east coast cliffs and due south of Roimata Point, there is a large north running valley that contains the East (Astelia) Stream (Figure 5.15). The headwaters of this East stream catchment start 200 m east of site R06-85 on the islands east coast cliff top at a point just north and west of the narrow, steep sided Cave Bay. This cliff top remains at a constant height as it extends north and forms a coastal ridge before finally dropping down over a steep scarp to become Roimata Pt. The seasonal waterway that starts here in the East Valley catchment is second only in size to the permanent South Stream located in the southern lowlands. It runs north for 160 m along a gently dropping gradient. From 160 to 300 m the stream starts to steepen moderately and is joined by a

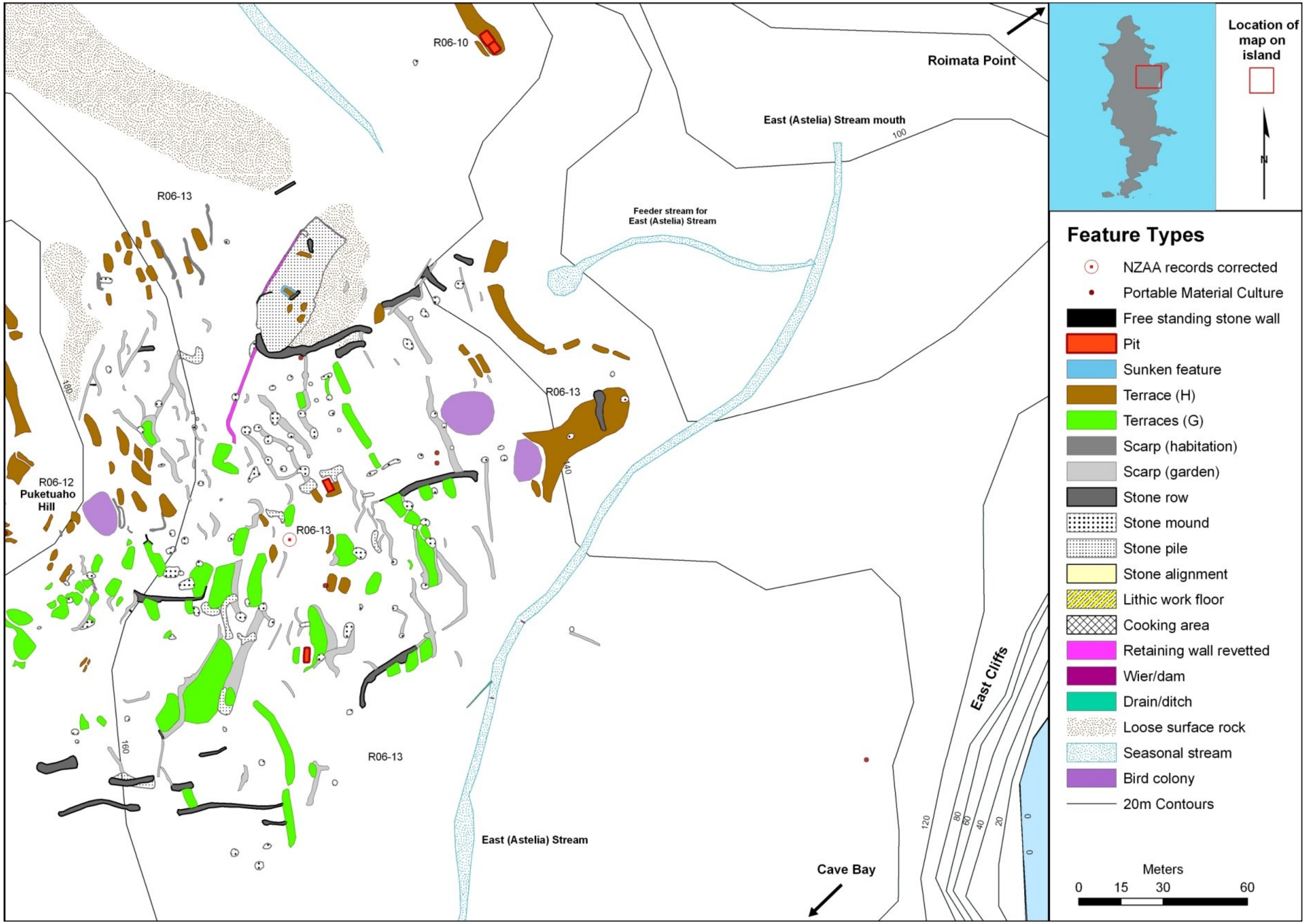


Figure 5.15 Geographic area 7 - East (Astelia) Stream Valley (R06-13).

minor tributary stream from the north. The final 50 m of the stream steepens as it enters the cliff top catchment before forming a waterfall over the vertical drop of the north-west coastal cliffs. Where the stream steepens, there is evidence of extensive erosion, indicating that although water on Tawhiti Rahi Island is normally in short supply this part of the island is subject to periodic inundations by cyclonic storm events - such as occurred with Hurricane Bola in 1987.

Description The eastern side of the East (Astelia) Stream catchment has a thin scatter of naturally occurring loose rock, however this area appears to be relatively unmodified by the islanders in that it contains only one single small stone scarp and associated small mound. Instead, nearly all the archaeological features associated with site R06-13 are found on the western side of the stream on an extensive area of gentle to moderate slope along the broad western flank of the East Stream valley. The core of this area extends for 200 m north-west/south-east and 220 m south-west/north-east and is situated immediately east of the vertical eastern cliff wall of Puketuaho Knoll and associated sections of the central ridge(site R06-12);north of a subtle point where the shelter of the raised Roimata ridge gives way to the slope down to Cave Bay; west of and above the steep sided gully that contains the watercourse of the East (Astelia) Stream bed; and south-east of the steep slopes that drop down to the source of the ephemeral feeder stream that joins the East (Astelia) Stream at its northern end.

The features in this core area form the most extensive cluster of archaeological structures to be found on the island. These structures include a series of 17 stone rows placed around the periphery that constrain 102 stone mounds, 13 stone piles, 110 stone faced scarps and 105 terraces. In addition, rarer features such as two storage pits and a single area of culturally deposited small stones are also found centrally located in the core. Immediately outside of the stone rows that contain the core, there are two clusters of very different features. To the south-east there are two dam/weirs and an associated man made drain in the Astelia Stream that has some similarity to features found in the Southern Stream Valley. Despite the slope south of the stone rows and north of the steep sides of the East (Astelia) Stream gully being similar gradient to that found amongst the features in the core area, there is a total absence of archaeological features in this 15-30 m wide area that extends along the gully for 200 m. It is significant that this type of 'feature gap' is also found between the archaeological features and the stream beds of both the Meander and Buller catchment areas. The second area of features outside the core is a rectangular area of piled large rock. This site appears to be unique on the island in that it consists of a repository for rock removed from other places that has been incorporated in and around naturally occurring medium to very large sized rock boulders. It is located on (or slightly inside) the north-west boundary of site R06-13 and consists of a 70 x 40 m area of natural and man deposited rock boulders defined by a series of large sloping scarps to the east, part of a stone row to the south and straight stone alignments on the northern and western sides. Inside these boundaries there is a mass of large rocks many of which show evidence of silicification. Among these have been constructed 12 stone faced scarps, two small enclosures, four terraces, two short stone rows and single examples of a mound and free standing stone wall. In the center of this feature one large central rock measuring four meters across has been split horizontally to reveal the process of silicification with the colour of the rock changing from dark grey on the outside to smooth 'porcelain' white rock at the center, interspersed with patches of a thin translucent layer of material that gave the appearance of a glass. This translucent material was initially thought to be a local source of rhyolitic obsidian but its toughness in resisting numerous rock hammer blows suggests that it is instead a rather extreme form of this silicification process. To the west and south of this rectangular feature all the surface rock has been removed, however to the east and north outside there is a remnant area of naturally occurring rock extending as far as a stone row. Amongst this loose rock there are two small stone faced scarps.

Interpretation (Core) The core area of archaeology in site R06-13 is broadly similar in composition to that found in the other sites on the northern plateau and is interpreted as a large garden area with associated habitation areas containing a complex pattern of stone and earth structures (Figure 5.16). This contrasts to the rarer features found outside the core that are interpreted as wetland gardens (to the south) and a specialist site (to the north). These three are discussed in detail below. The presence of primary down-slope running stone rows in this core garden area reflects a pattern that is well established in other gardens on Tawhiti Rahi and is consistent with the hierarchy of stone walls, found at Palliser Bay on the Wairarapa coast and in the Auckland stone fields, where longitudinal rows/walls are built first and then contour walls (or garden scarps here) run off them across the slope forming rectangular plots (H. Leach 1976:141; Sullivan 1972:155; Sullivan 1974:135). Helen Leach argues that these elongated rectangular strips between these rock structures, form the primary and long established unit of land division that is found throughout Polynesian (H. Leach 1976:140).

The large number of primary rows found here show interesting patterns that may reflect functional or cultural boundaries to the gardens northern, southern and eastern sides. The two central stone rows [Feature OBJID 560 & 2625] appear to create a south-west to north-east division through the center of the garden. It is possible that this division reflects an earlier period of gardening when the garden was initially smaller and only grew to its present large size over

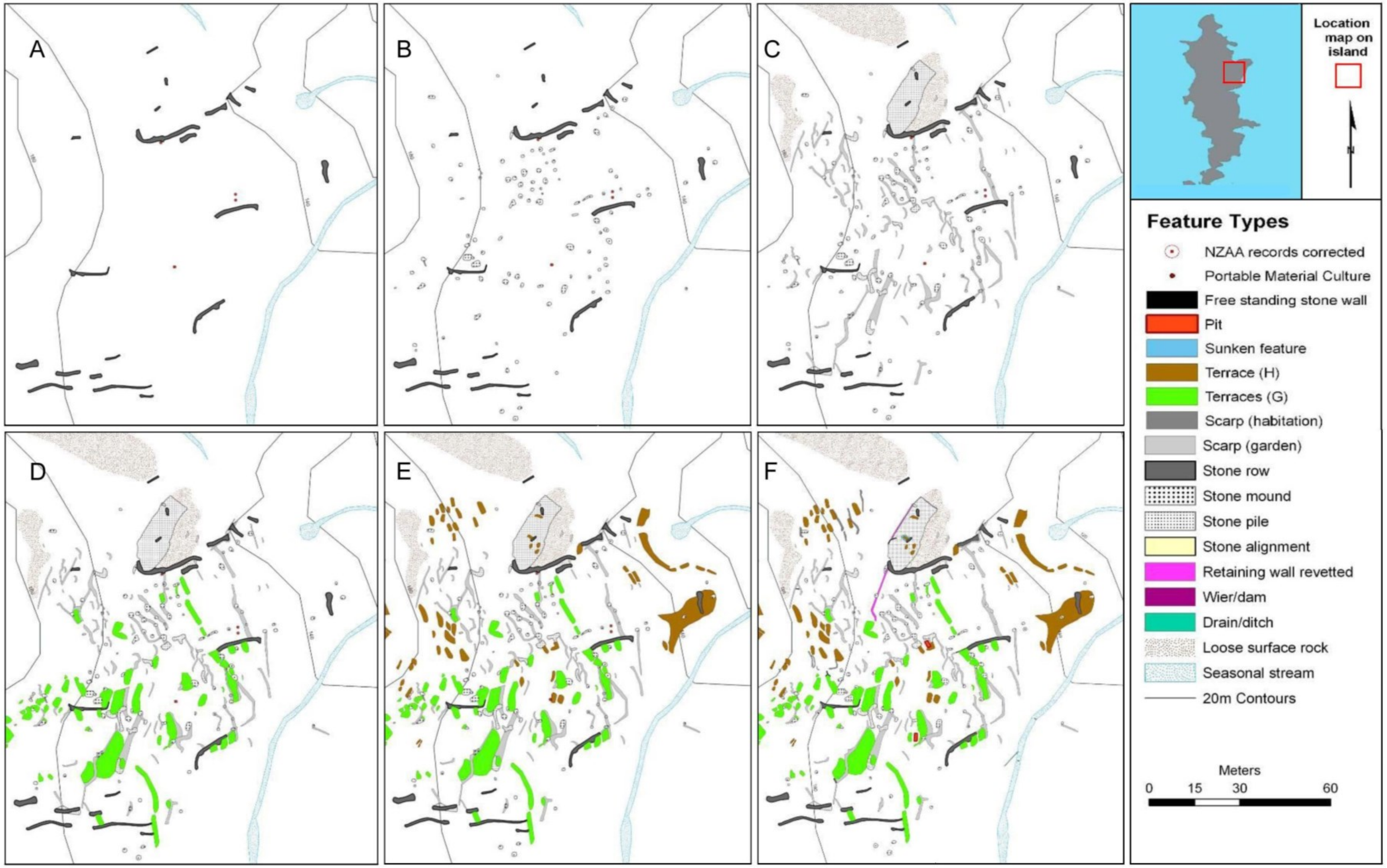


Figure 5.16 East garden R06-13: Deconstruction of a garden in six parts. (A) portable material culture & stone rows,(B) +Stone mounds, (C) +Stone scarps & stone piles,(D) +Garden terraces,(E) +Habitation terraces, and (F) + all other features.

time. Support for this idea of gardens expanding over time can be found with the last stone row to the north of the quarry and outside the core [Feature OBJID 1105] (see 'Partly completed stone row' text at top of Figure 5.17). This marks the end of a rock cleared area, and the start of what appears to be an unmodified rocky area characterised by gentle to moderate slopes that extends for north-west for 120 m to the edge of garden site R06-90. This northernmost stone row is made up of two adjacent parallel lines of laid rock with only a few 'fill' stones between them. When compared to other well preserved stone rows (for example Feature OBJ395 in West garden), it appears that this row was in the process of construction presumably at the time of the island's abandonment by Māori in 1823 (Plates 5.5&5.6). If this was the start of a northward expansion from the core of the East Garden, then its location creates three adjacent zones of roughly similar size within R06-13, each of which extends approximately 50 m across slope and 100-150 m down slope.

Three clusters of terraces bracket this large garden in the core area. To the west two clusters of nine and 13 small to medium sized terraces [e.g. Feature OBJID 913 & 953] are located on an area of well drained moderate slopes immediately east of the Puketuaho knoll (R06-12). To the east there is a cluster of 10 terraces located at the end of a large ridge top spur and an adjacent line of five terraces [e.g. Feature OBJID 772] that form a crescent along the boundary between the gentle slope to the south-west (that hold the bulk of the garden features) and the steep slope to the north-east that drops down to the convergence of the East Stream and its northern tributary feeder stream. Apart from the large terrace on the ridge top [Feature OBJID 2929], none of these terraces are associated with stone mounds or with portable material culture. Despite the lack of artefacts, these three clusters of mostly small terraces on well drained ground are interpreted as habitation areas.

<u>Interpretation (Outside the core)</u> The first of the two clusters of features outside the garden core is found to the south and consists of two stone dams/weirs and the single drain associated with the central area of the East (Astelia) Stream. Although lacking the stream bed terraces found in the southern lowland catchment (R06-28), the presence of similar dams/weirs here suggests that these too have aeration and water control functions. The single 20 m long drain between these two weir/dams is one of only five man made ditches so far located on Tawhiti Rahi Island. However unlike the other four drains that cluster above the North (Meander)Stream(R06-7) it is shorter(20 m), isolated,runs a cross slope and actually joins directly into the East (Astelia) Stream(Figure 5.15). This suggests that rather than being a boundary

marker in an area lacking in stone, this drain instead relates directly to water control for wetland gardening

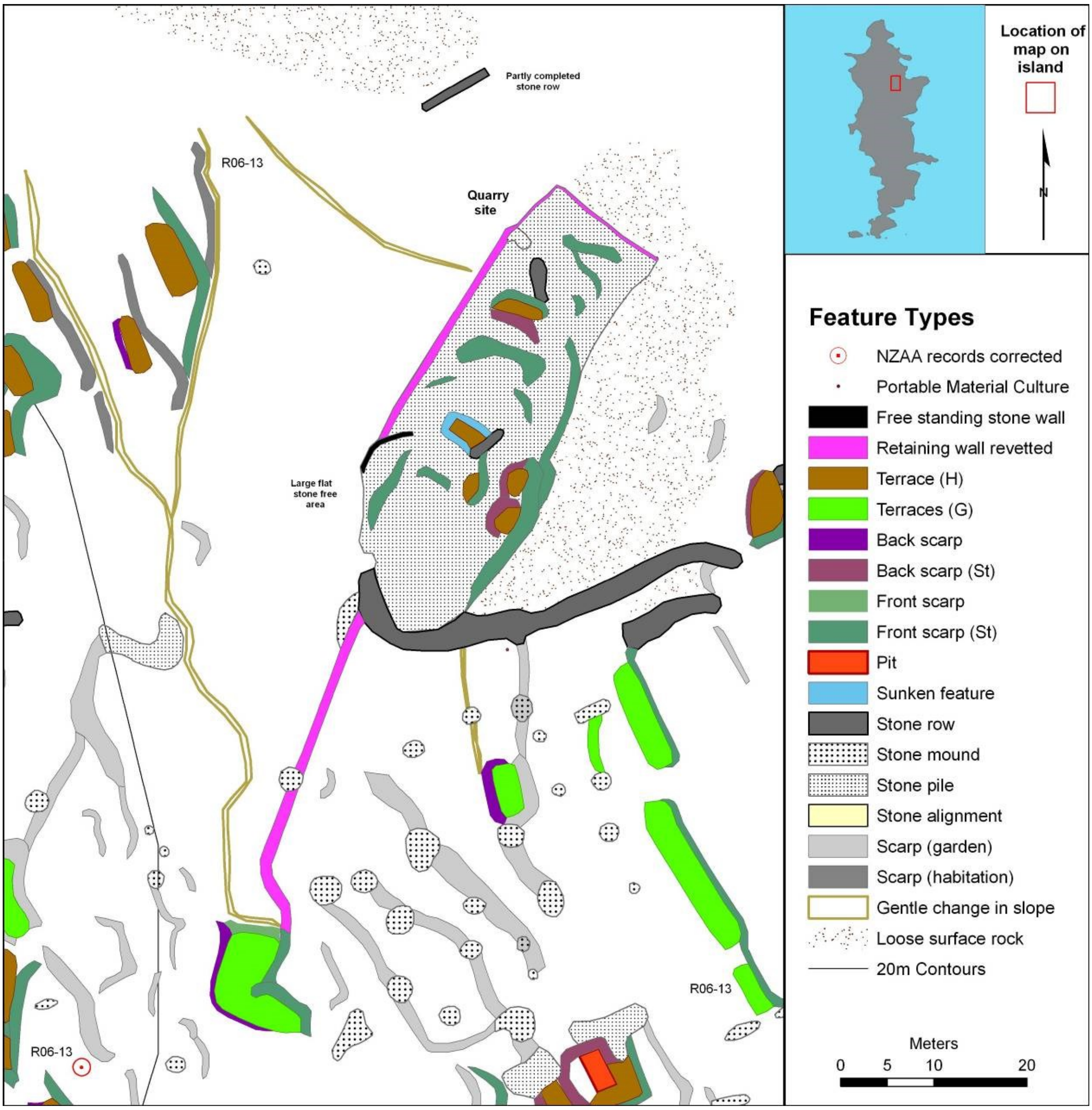


Figure 5.17 Geographic area 7 - Quarry site enlargement in the East Stream Valley (R06-13).

in this zone that lacks obvious features.

The second cluster of features outside the garden core is referred to as the Quarry Site (Figure 5.17). Clearly the large natural rock outcrop and associated large boulders were incorporated into the adjacent east garden primarily as a location where loose rock cleared from the garden could be readily dumped in and behind the man made boundary walls. However in addition to this function, the interior of this area was also modified with the construction of a few small terraces and sunken features/enclosures. The purpose of these constructed features is not clear. Among

Plate 5.15 Quarry site R06-13, split rock in the quarry stone pile.[Feature OBJID 2761].
[Welch 2005 Archaeology]

Plate 5.16 Quarry site R06-13, close up of porcelain white & glassy siliceous rhyolitic rock in the split rock. [Welch 2005 Archaeology]

the mass of natural rock bounded by the man made scarps, walls and rows is a large horizontally split rhyolitic boulder. The exposed interior of this siliceous rocklacks any cortex and so must have been only recently exposed to the elements. This suggests that local siliceous rhyolite occurring here may have been quarried here to produce flake tools – hence the name the 'Quarry site'. The idea of this being a quarry is possible since this rock has been found in archaeological contexts elsewhere on the island (see sites R06-24 & 85).

The idea that this is a quarry is not without problems (Plate 5.15 &5.16). On one hand, it is supported by the experimental knapping of local rock by Dr Marianne Turner who has shown that locally occurring highly siliceous rhyolite does have coinchoidal fracture characteristics, and holds a sharp edge, which makes it valuable to prehistoric communities (Appendix 5i). On the other hand, the lack of hammer stones or immediately obvious quarrying debris around this boulder does not support the idea that this specific area was in fact quarried. It is still unclear whether the obscure features within this area relate to a quarrying site or just to an opportunistic dump site for loose rock from the adjacent garden placed around large naturally occurring boulders and outcrops. This area needs further investigation. Until resolved, this unique construction with its rare features will retain the title of quarry.

5.1.2.8 Geographic area 8 - West Cliff (R06-85, R06-14 Nth &R06-14 Sth), Fig5.18

<u>Location R06-85</u> This site consists of a cluster of features located on top of a low broad north running central ridge that separates the catchment of the North-west (Buller) Stream valley that drains to the west coast, from the gentle slopes that lead down east to Cave Bay on the east coast (figure 5.18). It is bounded to the north by the start of the Buller Stream and by the abrupt rise of Puketuaho hill that is located on this central ridge. To the south this central ridge gently rises and broadens to join the wide western cliff top ridge knoll. To the east are the moderate slopes that drop down gently eastwards into the eastern river valley, while to the west there is a very gentle slope formed at the junction where the western and central ridges come together, and which drops gently to the north into the north-west (Buller Stream) valley. To a large extent this feature cluster is not topographically distinct, but rather is defined by the archaeology that includes few built structures but instead is dominated by portable material culture.

<u>Description R06-85</u> The exact archaeological boundaries of this feature cluster are open to interpretation. For the purposes of this research it is primarily bounded by stone row garden features of site R06-14 [North] to the west and by the garden features of site R06-13 to the east. To the south it is bounded by the habitation scarps, mounds and rows that make up site

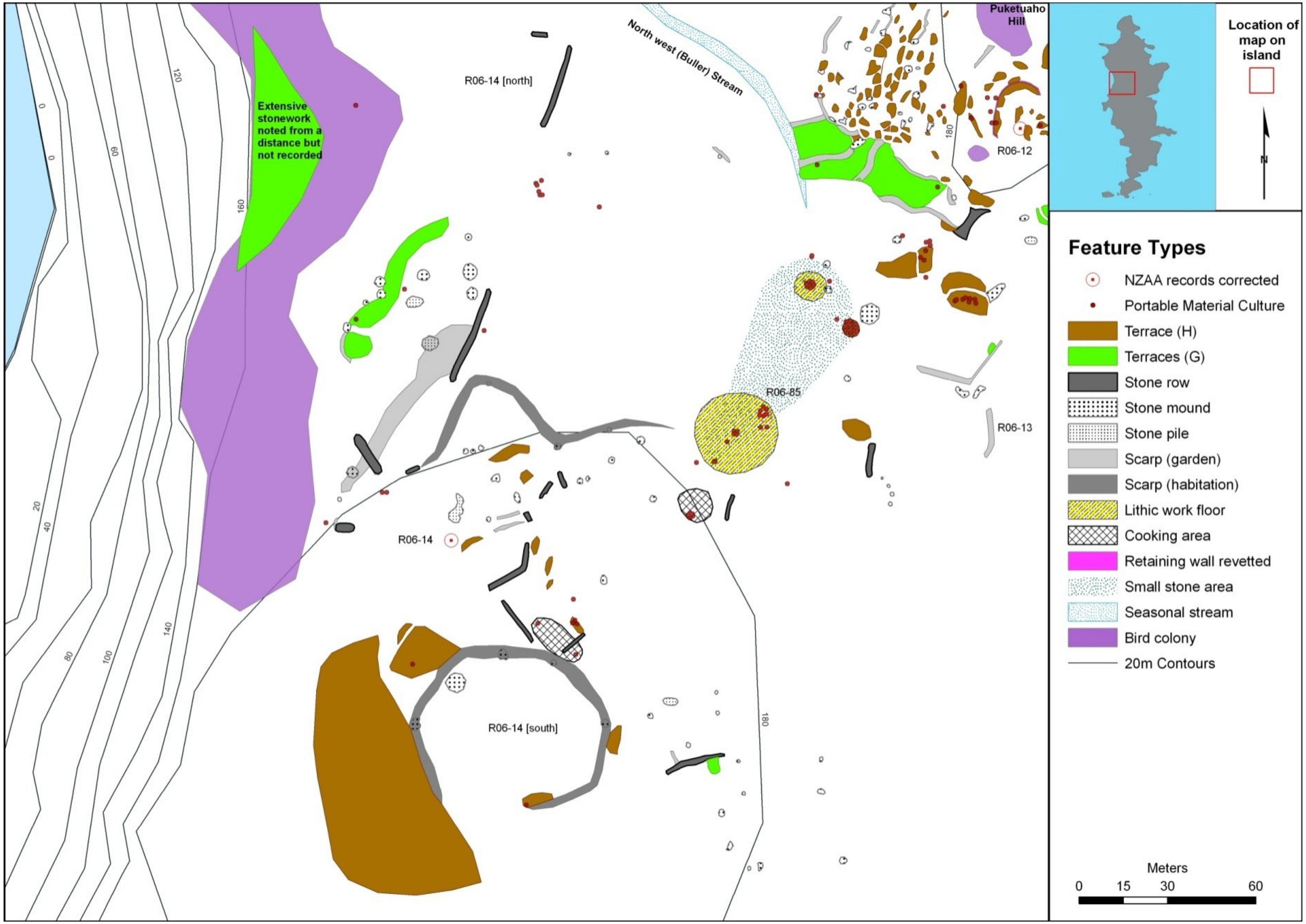


Figure 5.18 Geographic area 8 - West Cliff (R06-85, R06-14 north & R06-14 south).

R06-14 [South] while to the north it is bounded by the large river bed terraces on the south side of Puketuaho Hill (R06-12).

Within these boundaries this site is primarily defined by the presence of portable cultural material in the form of discrete clusters of stone tools in three lithic work floors that also contain occasional shell and fishbone. These clusters lie partly within a larger area carpeted with small stone and containing a low density of other lithics including culturally utilised chert, obsidian and sandstone. Like other obsidian clusters that occur on this ridge to the north of Puketuaho, this area contains groves of Karaka trees that were a recognised food resource. The only features in this site are a cluster of four small ridge top terraces immediately south of Puketuaho Hill. These contain quantities of obsidian flakes, ochre and fire cracked rock.

<u>Interpretation R06-85:</u> This feature cluster is considered a specialist area associated primarily with the production of flake tools but also food preparation as is shown by occasional examples of faunal material and fire cracked rock. It is possible that this site extends west for a further 80 m to include the area containing cooked pig bone [Point OBJID 152 & 153]. The purpose of the area surfaced with small stones is at present unclear. Small stones on their own could relate to lithic mulching (Lightfoot 1996), however the small stones are found in association with areas of charcoal stained soil, fire cracked rock and faunal material, raises the possibility that this was a mutton-bird processing site, similar to one inferred on Motukino (Fanal) Island in the Mokohinau Island group (Spring-rice 1980:101). However the lack of bird-bone means this can't be confirmed from the surface evidence.

<u>Location R06-14</u> The northern and southern parts of R06-14 consist of a cluster of features located in a 250 m area along the top and sides of this high and broad western cliff ridge. Starting in the south on top of a 60 m long by 60 m wide slightly raised knoll that forms a high point where the central and western ridges come together, this geographic area extends nearly 200 m northwards along the top and upper sides of this broad, gently descending ridge that ultimately joins up with the southern end of geographic area 5(Western Cliff North). To the west the ridge rapidly drops away to form the high vertical cliffs that are characteristic of the western side of Tawhiti Rahi Island, while to the east the ground takes a moderate slope that drops eastwards down into the catchment of the 'East (Astelia) Stream otherwise known as geographic area 7.

<u>Description R06-14 (south)</u> The southern part of site R06-14 is located initially on top of and on the sides of this unnamed knoll on the western cliff ridge. Defined by a distinctive

habitation scarp that nearly encircles the wide and slightly raised knoll, the broadly level interior contains a few stone mounds and one small terrace. Abutting this scarp to the west is a large terrace measuring 40 x 60 m that overlooks the western cliffs. Immediately east of this knoll on the side of the ridge which merges into the upper slopes of the East Stream catchment area, is an 80 m by 40 m area of features that include14 stone mounds along with one each of a stone row, stone faced scarp and a small terrace. On the ridge immediately north of this knoll there is a 60 by 60 m area that gently slopes down to the north. Bounded by the encircling scarp on the knoll to the south and a across slope habitation scarp to the north this area contains seven small terraces, 14 stone mounds, one stone pile, five stone rows and a 20 m by 10 m area of fire cracked rock and charcoal. Portable material culture recovered here is limited to fire cracked rock, charcoal and occasional obsidian flakes.

<u>Interpretation R06-14 (south)</u> This knoll feature cluster is considered a habitation area associated primarily with food preparation. The ridge top and the interior of the encircling scarp on the knoll are likely to have once had occupation structures while the cooking appears to have been limited to the area north of and outside the encircling scarp. The predominantly stone clearance structures on the slopes to the east of this knoll are interpreted as being a horticultural area.

<u>Description R06-14 (north)</u> The northern part of site R06-14 is located on top of the western cliff top ridge immediately north of the across slope habitation scarp mentioned above. Recorded features include a group of five stone rows that define a 160 m long north-south boundary, to the west of which are found twelve stone mounds and two terraces on the ridge top and upper western ridge slopes. This western part of the island has not been comprehensively surveyed due to the difficulty of traversing the extensive Buller seabird colony located here. However field notes from the surveying team identified from a distance, but could not access, a large single 70 m long by 30 m wide terrace off the western side of the ridge in a 'bowl' just above the cliff edge. Adjoining this to the east is an area of stone rows, stone scarps, stone alignments and enclosures immediately west of the northern most boundary stone row. This also has some seabird burrows and could not be comprehensively surveyed. The portable material culture recovered was extremely limited consisting of only three isolated obsidian flakes and one example of fire cracked rock.

Interpretation R06-14 (north) The minimal portable material culture along with terrace and stone features found here are consistent with gardens. Therefore this area is tentatively interpreted as a horticultural zone. This northern part of site R06-14 needs further investigation to confirm both its extent and function.

5.1.2.9 Geographic area 9 - West Cliff South (R06-86 & R06-87), Figure 5.19

Location: On the western side of the island there is a wide and level ridge top that falls within the highest (180 m) contour interval present on the island. The middle section of this cliff top ridge that forms the 'Western Cliff South' geographic area extends along the western side of the northern plateau for 600 m. It is bounded to the north by site R06-14 (geographic area 8) on the small knoll and to the south and east by garden site R06-15 and habitation site R06-16 (geographic area 10) that overlook the southern escarpment. To the east of this area there is a gentle to moderate slope that descends eastwards at a consistent angle for 250 to350 m until it reaches the east coast cliffs. To the west the slope drops moderately for about 100 m to the 140 m contour. After this the slope steepens and quickly becomes a cliff that drops vertically to the sea. Although broader at its northern and southern ends the flat top of this ridge is never less than 50-80 m wide (Figure 5.19).

Description This section of ridge top is the least well understood section of the island, and only a small number of features have been recorded. This is due in part to the reduced occurrence of naturally occurring loose rock that elsewhere on the island has been modified by the inhabitants to make distinctive archaeological feature clusters. The main reason however is the presence of the largest Buller Shearwater breeding colony found on Tawhiti Rahi Island, which significantly restricts present day access.

The features that were recorded were found clustered in two isolated areas. 75 m south of knoll site R06-14there is a single large 20 m long terrace that faces east overlooking the gentle slope to the interior (R06-86).It is associated with two stone clearance mounds built in part on small outcrops of natural rock. No portable material culture was located. It is possible that there is another terrace immediately adjacent to the east however the presence of low density bird burrowing has obscured this area. 150 m to the south of R06-86 there is a cluster of seven smaller stone faced terraces and one stone mound built on the top of a 150 m diameter low knoll on the ridge top (R06-87). Again this area has been extensively bio-turbated by the Buller Shearwater in the past and it is only the presence of natural and culturally placed rock at thehighest point that allows these features to be somewhat protected and therefore identifiable.

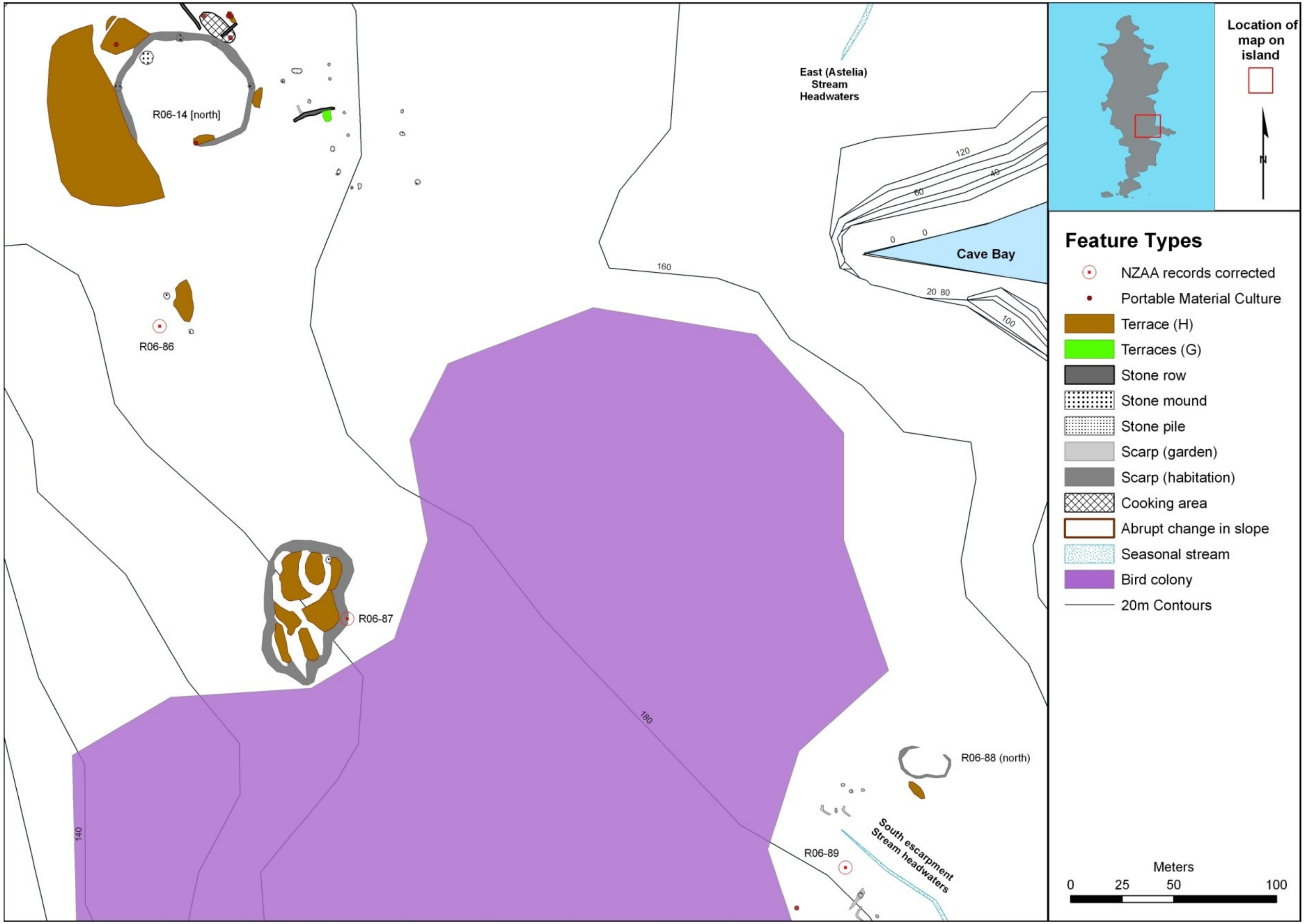


Figure 5.19 Geographic area 9 - West Cliff South (R06-86 & R06-87).

To the south-west of these recorded features some associated features have been noted from a distance. These include five or six huge earth terraces descending west down the gentle slope of the knoll towards the western cliff top; however these could not be accessed as they are located in a high density area of bird burrows. No portable material culture was identified here during the survey.

<u>Interpretation</u> Although only part of this area was accessible for survey and no portable cultural material was recovered, the features that could be recorded are considered to be a habitation area due to the presence of well drained small terraces on a distinctive but small knoll located on the ridge top. The function of the larger terraces reported but not recorded descending to the south-west is at present unknown.

This section of island needs further investigation. It is unclear whether the lack of artefacts on this knoll is real or just a result of the current limited investigation. Confirming the presence of large terraces on the south-west slopes of this coastal ridge is particularly important in determining whether these west facing slopes above the vertical western cliffs were a significant horticultural area for the islanders. In particular we need to determine if these terraces are similar to those highly modified terraces found on the north slopes of geographic area 8 to the north or, whether they instead resemble the horticultural stone and earth work features recorded within garden site R06-15 to the south in geographic area 10.

5.1.2.10 Geographic area 10 - South Plateau Escarpment (R06-15,16,88,89),Fig5.20

<u>Location</u> This southern plateau geographic area 10 extends across the whole width of the island at the southern end of the plateau that forms the northern two thirds of Tawhiti Rahi (Figure 5.20). As such it forms a block that extends 100 to 150 m north-west to south-east and 300-350 m south-west to north-east and incorporates the southern end of the western ridge and the long gentle slope that drops east towards the eastern cliffs. The area is bounded to the west by the moderately sloping upper western slopes of the western cliff top ridge that themselves overlook the island's vertical western cliff that drops to the sea. To the east the boundary is the eastern ridge top cliff that again drops vertically to the sea. 50 m to the north along this eastern ridge top cliff is a small knoll containing site R06-88 that forms the northern boundary of this geographical area 10. To the south-west are steep escarpment cliffs that drop directly down to the southern lowlands.To the south-east this geographical area includes an intermediary 'bowl' shaped catchment area drained by the small ephemeral south running stream.

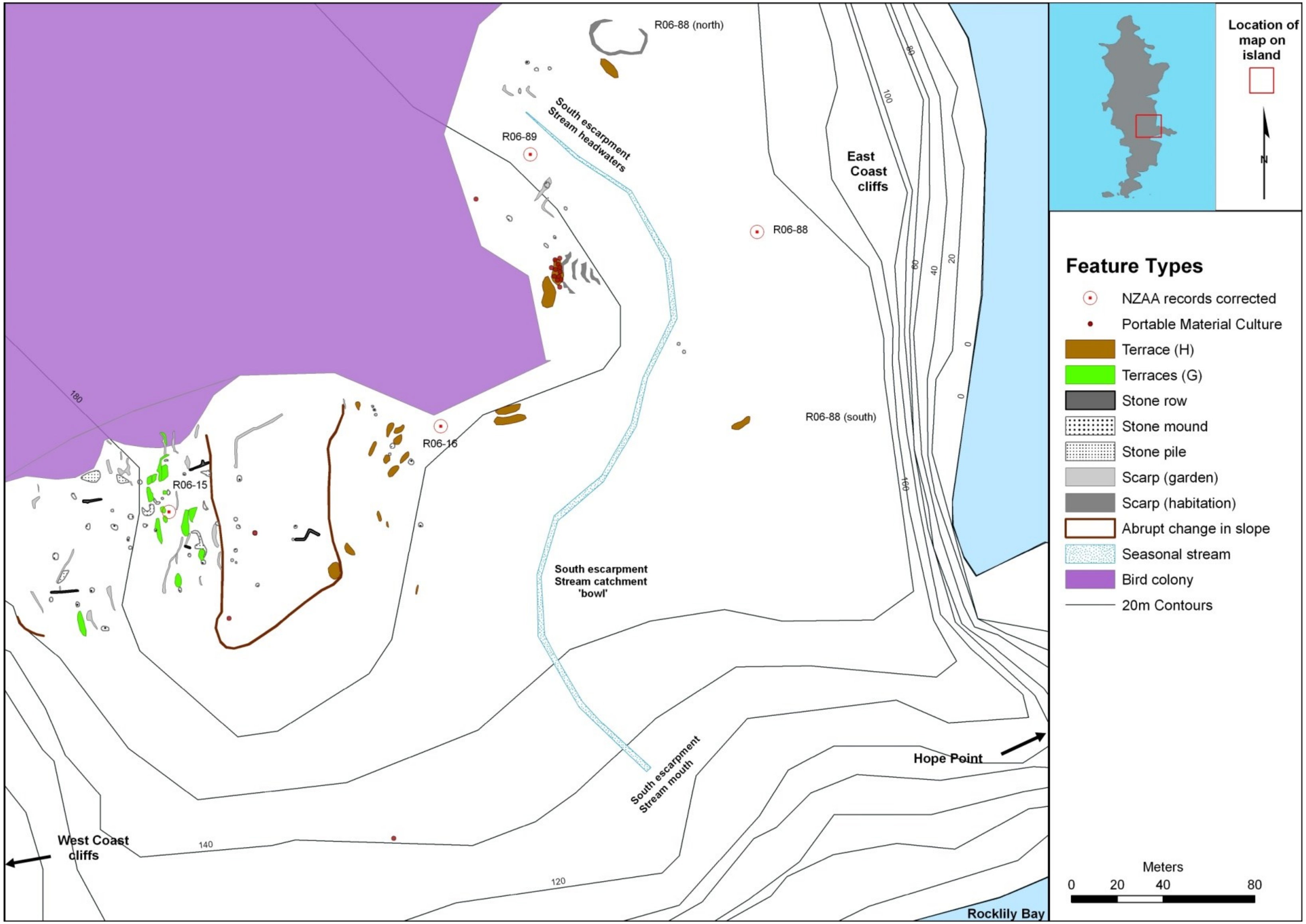


Figure 5.20 Geographic area 10 - South Plateau Escarpment (R06-15, R06-16, R06-88 & R06-89).

This is titled the 'South escarpment stream. The stream catchment has moderate slope on its western side and a gentle slope to the east. The fall of this stream is gentle and does not form a clear gully until it reaches the steeper escarpment slope south of the 160 m contour line that drops directly down to the southern lowlands.

<u>Description R06-15</u> Here on the top and the western sides of the southern end of the western ridge cliff top there is a cluster of features that extends for 90 m north-south and 130 m west-east. On top of the ridge there is a level area measuring 50 m west-east by 100 m north-south which is defined by an abrupt slope change on the west, south and east sides that follows the approximate 200 m contour line, and a garden scarp and single stone alignment cutting off the ridge on the northern side. Within these boundaries are found a scatter of 10 stone mounds, and one stone row. Only two examples of portable material culture found in site R06-15. These were located on this ridge top and consisted of one twentieth century historic beer bottle and one obsidian artefact [Point OBJID 73 & 242].

The western flank of this cliff ridge top contains a much denser cluster of features within a 80 x 80 m moderately sloping area located immediately west of the level top of the ridge and east of the vertical cliffs that drop down forming the western coast of the island. Within this west sloping area has been constructed earthwork and stonework features that include 32 stone mounds, 10 stone piles, 24 garden scarps, 15 terraces and one stone alignment. The terraces are clustered up slope near the top of the ridge while the rows all run down hill. No portable material culture was located amongst these archaeological features.

<u>Interpretation R06-15</u> The features located on both the ridge top and the west slopes are considered to be horticultural in function. This interpretation is based on the presence of stone rows that may be field boundaries as well as a strong and reoccurring association between numerous stone mounds/piles and stone faced garden scarps. Further support for this interpretation comes from the insignificant amount of portable material culture identified.

<u>Description R06-16</u> Here on the eastern side of the southern end of the western ridge cliff top there is a cluster of features that curve around on the moderate to gentle slopes formed by the western side of the South escarpment stream catchment. Site R06-16 is located on the western slopes of this catchment in a band that runs about 40 m up and down slope and 180 m along the slope. This site is made up of 13 small (5-8 m long) terraces, three large (10-15 m long) terraces, eight stone mounds and six habitation scarps. The southernmost

of the smaller terraces has a rare raised stone rim on it and would have had a clear view over the southern lowlands if the current vegetation was removed. The two northern most terraces next to track markers 52 and 53 are associated with a series of 4 stone scarps descending towards the South escarpment stream. It is possible that one or more terraces exists amongst these stone faced scarps, however these cannot as yet be confirmed due to extensive bio-turbation damage from burrowing seabirds as well as limited survey access to the area during the breeding season (Figure 5.39). The portable material recovered from this site included a broad range of faunal and lithic material, all found at the northern end of the site in and around one terrace [Feature OBJID 2855] of a two terrace cluster.

<u>Interpretation R06-16</u> The features recorded here are dominated by clusters of small terraces located on a well drained south facing slope. As such this group of structural elements is currently interpreted as a habitation area. The erosion course of the stream across the southern end of the plateau and down the escarpment to the south has provided the easiest access way for people today and in the past to move between the southern lowlands and the northern plateau (see access track). At present it is unclear what, if any impact, this communications route might have made on the type and location of archaeological features here. However the fact that (i) some of the shellfish and the obsidian found were not locally sourced but rather imported to the island (see Chapter 5 Section II) and that (ii) they were all found on one single terrace close to the obvious route between the major landing site in the south (R06-29) and the cluster of garden and habitation sites in the north, hints at an association that may be worth investigating in the future.

<u>Description R06-88</u> The eastern slopes of the headwaters of the South escarpment stream rise slightly to merge with the short and gently rising western flanks of the western cliff top ridge. From a point 50 m north of the source of this stream, this minor raised cliff ridge is too small to be visible in the 20 m contour intervals but winds southwards for 160 m paralleling the route of the Southern escarpment stream before ending at the upper slopes of the escarpment. A small number of features are found scattered widely along this ridge and are recorded as site R06-88. At the northern end of this ridge adjacent to the source of the stream there is a minor knoll on the cliff top ridge defined by a 20 m north-south and 50 m west-east habitation scarp that nearly encircles a large level area on the knoll top and at least one terrace overlooking the stream catchment. Like the similar knoll (R06-87) on the west cliff top ridge this one has been extensively modified by burrowing seabirds. 170 m away at the southern end of this ridge there is a single 10 m long terrace that overlooks the escarpment, Rocklily Bay and the current route down to the southern lowlands. The eastern side of the eastern cliff ridge at a

point mid way between these northern and southern features there is an area of moderate slope measuring approximately 100 m north-south by 25 m west-east located immediately above the vertical cliff that drops to the sea. Due to time constraints this area has not been archaeologically surveyed, but unconfirmed reports from previous visitors to the island suggest it might contain terracing and stone features (Figure 5.20).

Interpretation R06-88 Although only part of this area has been comprehensively surveyed and although no portable cultural material has been recovered, the features that were recorded are all found on the well drained ridge top. The features on the ridge top knoll to the north and the single terrace on the ridge top to the south effectively 'book end' a number of unconfirmed terrace and stone constructed features in an area that has been heavily bird bio-turbated in the recent past. Due in part to the similarity of the knolls encircling scarp with the one found at habitation knoll R06-14 (south) in geographic area 8 on the western cliff, these features are currently considered to be a habitation area. Further comprehensive investigation is required to determine (i) if the unconfirmed terraces and stone structures reputed to be on the eastern side of the cliff top ridge are part of the ridge top habitation area, or if they are part of an as yet unexplored horticultural area, and (ii) the full extent of the highly bio-turbated knoll on this eastern cliff ridge.

DescriptionR06-89 The long and gently sloping eastern flanks of the western cliff meets the headwaters of the South escarpment stream and then rises slightly to join a minor raised cliff ridge on the eastern cliff top that is too small to be visible in the 20 m contour intervals. Between the knoll site component of site R06-88 on the cliff top ridge to the north-east and the northern most cluster of terraces of site R06-16 to the south (at track markers 52&53) on the western slopes of the South escarpment stream, a small number of features are found scattered in and around the South escarpment stream headwaters and are recorded here as site R06-89. Near the source of the stream where the slope starts to rise gently to the east there are found a cluster of four small stone mounds, two garden scarps and one small stone alignment. 35 m to the south where the slope starts to rise gently to the west there are five small stone mounds and two garden scarps. These all occur among a surface distribution of natural unmodified volcanic rock. The only portable material culture identified was a single obsidian flake [Point OBJID 1599].

Interpretation R06-89 This part of the South plateau (geographic area 10) has not yet been comprehensively surveyed. The dominance of stone mounds and stone scarps around the sheltered and fertile headwaters of the south escarpment stream is reminiscent of features found around the Meander Stream at the northern end of the plateau and therefore these features are interpreted as being part of a garden system. The fact that two deflated mounds are found adjacent to the stream at a point 130 m to the south of this cluster of garden features hints that a much larger area of the South escarpment up to and including the South escarpment stream 'bowl' may also have been used for gardening. The location of the single obsidian flake at the extreme western edge of these features and on the existing access track hints that it might be an accidental loss and might not be associated with this site complex (Figure 5.20).

5.1.2.11 Geographic area 11 - South Stream Valley Lowlands (R06-17, 19,20,22-25 & 29), Figure5.21

Location R06-17, 18 & 19 The west side of Tawhiti Rahi Island is mostly characterized by 180 m high vertical rock cliffs that drop to the sea. In three places high, narrow ridge spurs descend west from the cliff top and form tall headlands. The southernmost and largest of these headlands is a high narrow ridge spur that starts at the top of the escarpment that forms the southern end of the plateau and descends steeply to the west ending in a headland that forms the northern boundary of Camp Bay (Figure 5.21). Half way down the headland ridge there is a high point/knoll named the 'Citadel' by Pickmere in the 1920s. To the south the top 30 m of the knoll has a vertical slope due to the exposed columnar volcanic rock outcrops. Below theses the slope moderates abruptly and descends south towards Camp Bay. At the 20 m contour the slope again becomes vertical and drops down to the sea. On the northern side of this headland ridge there is a vertical coastal cliff that drops directly to the sea. Where the north side of this headland joins the island's western cliff face, there is a steep scree gully where, over time, large boulders have fallen forming a small beach at sea level. About 80 m up this gully there is a large cave that extends back into the hill side (R06-17).

Description Rock Shelter R06-17 A number of naturally occurring dome caves are known to exist on the Poor Knights Islands. Formed through a process of rain percolation erosion of the volcanic strata, they are found both above and below the present sea level, which must reflect their formation over geological time periods when glacial and interglacial periods caused the sea levels to vary in height by up to 200 m. The dome shape of most of the caves provides a natural strength that gives them a degree of permanence, and this is best seen in Rikoriko cave, the

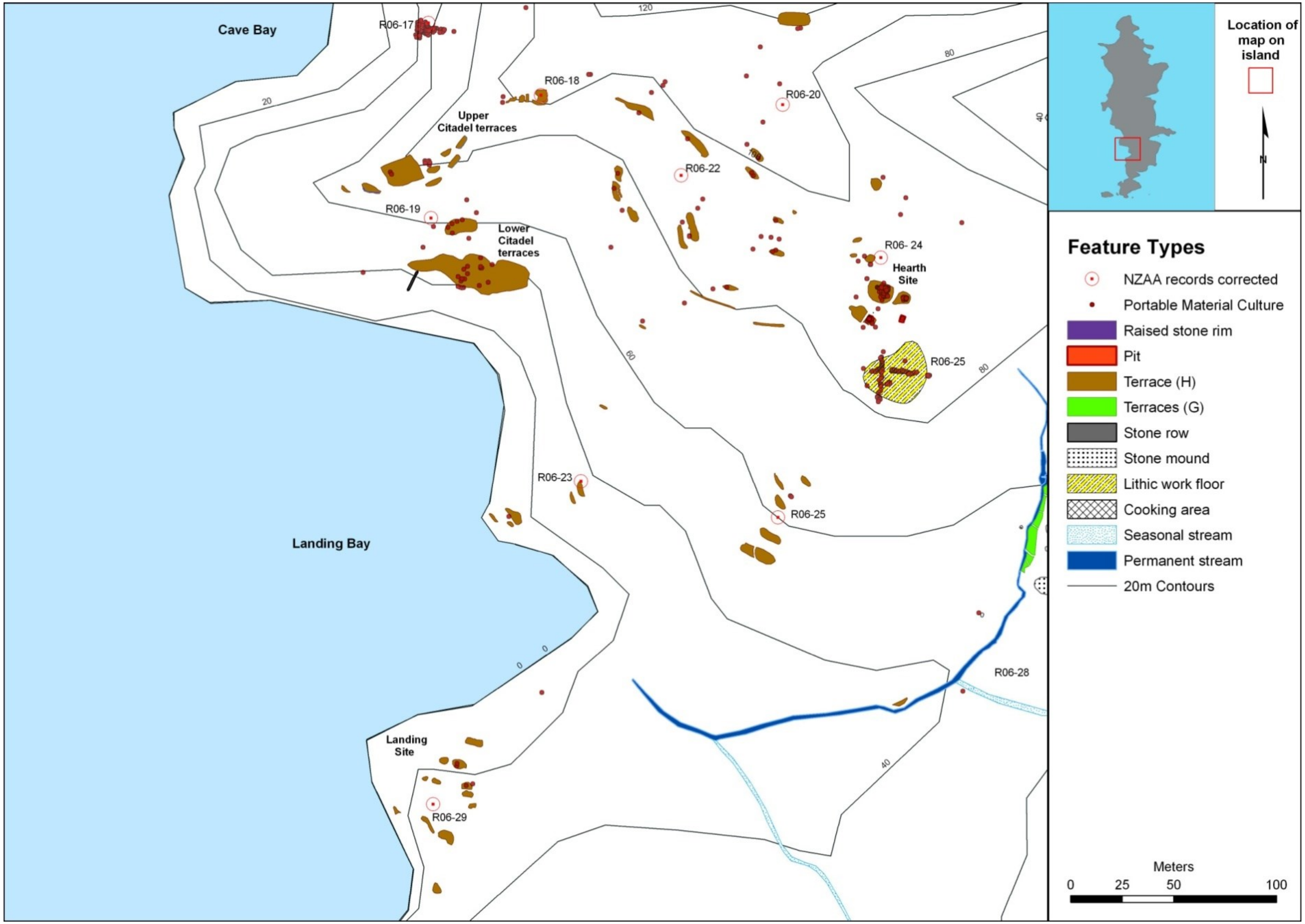


Figure 5.21 Geographic area 11 - South Stream Valley Lowlands (R06/17-19, 20, 22-25 & 29).

largest cave known from the Poor Knights Islands. This partially flooded cave is over 100 m wide and 50 m tall and is located on the eastern side of Aorangi Island. The cave on Tawhiti Rahi Island that encompasses rock shelter R06-19 is also a dome cave. It is 10 m wide at the mouth and it extends 20 m back into the hill where it narrows down to 3 m in width. The roof height at the opening is 8 m and this remains constant for first 15 m before it drops rapidly to a 50 cm height at the rear. Through this narrow rear gap a further small cave opens out (See Ch 5 Part II). Access into this cave is not easy but is possible either by a sea landing and then climbing up the scree slope, or by walking over the saddle of the Citadel site (R06-18) and down the steep but not quite vertical cliff edge. The cave is defined here as a rock shelter because it contains clear evidence of human activity. Outside of the drip line located at the entrance of the rock shelter there is evidence that a stone retaining wall was constructed and possibly backfilled to stabilize the cave floor. Inside there is a roughly level surface characterized by a red or grey soil on the floor that varies between damp and dry depending on rain seepage from above. Near the entrance there is a 2 m wide zone that is either undermined or collapsed by seabird burrows. It is presumed that these ground dwelling birds re-colonised the cave sometime after the island was abandoned by people in 1823.

The interior surface of the rock shelter shows clear evidence of prehistoric occupation, with a scatter of well-preserved artefacts and features. Although no obvious human made modification to the cave structure has occurred inside the drip line, discrete concentrations of charcoal visible on the cave floor identify a series of four open fires. A series of water rolled boulders form a line across the floor in front of the rear cave. The largest artefacts found are eight sections of wood scattered over the floor of the rock shelter, two of which show adze marks (OBJID 1012 & 1208). These are identified and sourced to native species types (see 5.2.3.1; 5.3.3; & Appendix 6ii). In addition to the four open fires, the floor of the cave is covered with a thin layer of charcoal, fishbone, as well as occasional sandy and rocky shore shellfish and a scatter of lithic artefacts. Apart from the fishbone that dominates this assemblage, isolated faunal material recovered includes bird bone and a fragment of pig mandible. Scattered throughout the cave and amongst the charcoal are Placostylus land snail shells. Apart from the water rolled boulders of granite, the only other lithic material identified on the floor of the rock shelter is a small scatter of worked obsidian and a single silicified rock core [Point OBJID 950].

<u>Interpretation Rock Shelter R06-17</u> This rock shelter shows well preserved evidence of occupation by Māori. It is clear that fish and shellfish were cooked and eaten here. Although

most of the species could be caught locally, the sandy shore shell fish such as tuatau and pipi must have come from estuarine environments not found on any of the Poor Knights Islands. Stone artefacts such as the water rolled basalt boulders and obsidian are also not local and most likely came from either the Northland mainland or Great Barrier Island.

Dating of the last period of Māori occupation of the cave can be inferred from the stone adze marks on a section of Mahoe wood and the fragment of pig jaw exposed on the floor of the rock shelter. Since stone adzes were replaced by metal tools early in the 1800s and pig was only introduced to New Zealand sometime after Cooks first visit in 1769, this suggests that at least the last phase of occupation in this rock shelter occurred in the decades immediately before or after 1800AD. This is in keeping with the Native Land Court accounts that identify a hidden cave on Tawhiti Rahi in which a small number of the inhabitants safely hid during the inter tribal attack of 1823 (see Chapter 2).

The Placostylus land snails found in the cave are native to the island but it is unclear why they would naturally inhabit a cave that lacked their preferred plant food. Haywood and Brook (1981) have argued that they may have been deliberately brought to the cave and cooked and eaten. Although no other examples of land snail consumption are found in the New Zealand archaeological literature, there is good evidence that they were used as a food source in Melanesia (Hayward & Brook, 1981: 350).

The line of water-rolled basalt rocks have been variously interpreted as a hearth (Hayward, 1983) and as a conceptual boundary (Robinson, 2004).Earlier visitors to Tawhiti Rahi reported an alcove in rock shelter R06-17 containing obsidian and hair tufts similar to material found in a cave on the adjacent Aorangi Island that suggested an association with ceremonial hair cutting (Wilson, 1959: 124). We did not identify such an alcove during this field work however if it was located in the small rear cave it may be under a recent rock fall. If this historically reported alcove was located in the smaller rear cave then the row of water rolled boulders across the rear of the front cave may have been a delineated boundary between the 'noa' (profane) outer and 'tapu' (sacred) inner parts. If not, then the incompatible tapu (hair cutting) and noa (shell fish food) material found in the rock shelter may instead reflect functional change over time, especially when the cave was used as a hidden refuge in 1823 (See Chapter 3).

From the surface material recovered in this rock shelter it cannot be determined whether the inhabitants were resident islanders or transient visitors and how far back in time their occupation may have extended. To address the questions of when and why the cave was used, an excavation was carried out in this rock shelter, the results of which are discussed in Chapter 5 Section II.

Description Citadel R06-18 The citadel site is located on top of a natural knoll on this ridge that was formed by differentially eroding columnar basalt. A tight cluster of 5 small terraces extends for 40 x 10 m on and around the naturally occurring rock of this steep sided knoll. On the knoll the sub-vertical walls that level and infill areas of columnar basalt to form terraces, On one of the small upper terraces there are koiwi (human bone) associated with planks from a canoe [Point OBJID 110& 1695]. Only one obsidian flake artefact was recovered here and the area of the site is devoid of midden (Figure 5.21).

Interpretation Citadel R06-18 This group of features on this knoll (R06-18) was originally interpreted by Haywood (1982) as a pa (defensive hill fort) and that the eastern most terrace was the pa's outer defensive ditch, that was cut into the natural rock separating the site from the dispersed habitation features to the east (R06-22, 23, 24 & 25). However the features identified do not appear to be defensive in nature. Our inspection suggests that instead of being a ditch, it is rather another retained terrace that forms a conceptual boundary between the tapu and the noa zones.

On the knoll the fact that the terraces lack domestic rubbish and the one at the summit contains human bone (koiwi), suggests that this knoll has a ceremonial function similar to sites R06-6 and R06-12 that are found on the islands other natural high points. When compared, all three sites lack faunal remains, and lithic artefacts are scarce or absent; two contain burials (R06-12, R06-48) and three contain terraces with raised rims (R06-6, 12 & 18). One of these raised rim terraces was excavated (R06-12) and found to contain a crouch burial (See Chapter 5 Part II). Physical boundaries between the tapu areas on these high points and the noa areas of habitation and horticulture below, include natural cliffs that have been augmented by man-made features such as the very rare free standing sub-vertical walls (R06-6, R06-12) and, at this site, a terrace cut directly into the rock so forming an uphill saddle (R06-18). It is argued then that all three are urupa (burial) areas.

Description Lower Citadel Terraces (R06-19) A cluster of archaeological features have been recorded below the vertical columnar rock wall that forms the south and west sides of the Citadel knoll (R06-18). Those features start on the lower ridge top to the west of the knoll and extend southwards down the moderate slopes to the south of the knoll to a point immediately above the 20 m high vertical cliffs that drop into the bay. A scree gully separates these features from the dispersed habitation settlement to the east (R06/20-25), while to the west the features end some distance back from the western end of the headland.

A total of four stone alignments, one stone row and ten terrace features are found on the top and southern side of the spur ridge (R06-19). Eight of these terraces are found on the headland ridge top and two of these eight have raised stone rims. Nearly all of these eight terraces would have had strategic value due to the good views they have from the north-west through to the south-west. A total of nine examples of lithic and faunal portable material culture were identified on these terraces. These consisted of local rhyolitic stone as well as imported obsidian and only sandy shore shell fish. The area on the southern slopes of the headland contains one moderate and one very large terrace that are associated with a short stone row, four stone alignments and 29 examples of portable material culture that are comprised of ten water rolled boulders or pebbles, 21obsidian flakes and one obsidian core. The only faunal material was one example of tuatua, an imported sandy shore shellfish.

<u>Interpretation Lower Citadel Terraces (R06-19)</u> The features recorded on the lower ridge top are dominated by small terraces and a very small amount of lithic and faunal material. At this point in time these are broadly interpreted as a habitation area, however the presence of raised stone rims on two of the eight terraces suggests that they may be associated with burials (as is the raised stone rim terrace found on the summit of Puketuaho). If correct then these ridge top features could be seen instead as an extension to the Citadel ceremonial area (R06-18) located on the adjacent uphill knoll to the east. A final determination of function will have to wait until a future sub-surface investigation is carried out.

The two lower terraces to the south of the ridge top are clearly a discrete unit. It is significant that the very large lower terrace contains the bulk of the obsidian flake tool artefacts and is situated immediately above an area of smooth cliffs that drop down to the sheltered waters of Camp Bay. As such it is the only area large enough and low enough around Camp Bay that could be the location for the area that traditions report was used to store and shelter canoes that could not land on this cliff girt island (see Chapter 2). It is in fact the only place around Tawhiti Rahi where canoes could be 'rolled' up vertical cliffs using ropes, stored safely and repaired as is traditionally recorded (Hetaraka 2008 and pers. comm. 2000). Together these points suggest that these lower features have a 'specialist' function associated with canoe access to the island.

<u>Location Dispersed Settlement Sites R06-20, 22, 23, 24 & 25</u> These sites are situated in Camp Bay found on the south western quarter of Tawhiti Rahi in the southern lowlands and

facing west towards the Northland mainland. The five sites identified above can be seen to be part of a single 'dispersed settlement' comprising 40 terraces scattered over a 200 x 200 m area located on the sheltered northern inner side of Camp Bay (Figure 5.21). Within Camp Bay these sites are bounded to the west by the northern headland ridge, to the north by the foot of the escarpment cliffs that rise up to the northern plateau, and to the south and east by the South (Charles) Stream, a permanent water source that drains the East garden catchment. As a group these dispersed settlement sites extend south and west on the side slope of the narrow north-west/south-east running saddle at the foot of the main escarpment. On this gentle south-west slope, the initially undifferentiated ground becomes moderately steep and breaks up into three minor ridges separated by small gullies. Immediately above the water of Camp Bay, the slope becomes vertical and forms broken barrier cliffs 10 to 20 m high that are the distinguishing characteristic of this island.

<u>Description Dispersed Settlement Sites R06-20, 22, 23, 24 & 25</u> This scatter of mostly terrace features is found over a 200 x 200 m area of gentle undifferentiated slope and of moderately steep minor ridges. Archaeologically the site is bounded by the Citadel to the west (R06-18) the canoe terrace (R06-19) to the south-west, the landing terrace to the south (R06-29) and to the features in the South Garden to the east (R06-28). As a group these features are described as a dispersed settlement and are comprised of mostly stone faced earthwork terraces and as a unit encompass the previously recorded sites R06-20, 22, 23, 24 and 25. Unlike the large lower Citadel specialist area to the west (R06-19b), the terraces here are consistently small, measuring 3 to 8 m in length and 1 to 4 m in width.

As a group the terraces have some common attributes including a scatter of worked obsidian flakes and most have one or more imported water rolled boulders. Differentiating attributes include the presence of the island's largest lithic work floor (northern part of R06-25), faunal material in the form of shellfish, fishbone and bird bone debris being limited to the eastern part in sites R06-24 and R06-25, and the discovery of the unique carved panel cached under a sheltering rock in the central area.

<u>Interpretation Dispersed Settlement Sites R06-20, 22, 23, 24 & 25</u> The nature of this settlement is unique compared to the rest of the island in that the terraces are not clustered, rather they are dispersed, forming discrete groups of single, double or triple terraces spaced out on the west facing slope and minor ridges. Strategically it is an important place as the people living here could control the only two landing sites (discussed below) and the only permanent

water source available on the islandSouth (Charles) Stream. This location suggests that occupation in this area is likely to be both early and to have been ongoing throughout the islands human history. The discovery of a cached carved panel (discussed in Chapter 5 Part III) showing evidence of both stone and metal tool use suggests that occupation here continued into the early historic period.

It is the dominance of common generalist features that have led to this settlement being interpreted as a habitation area. If the terraces to the west are general whanau (family) housing, then site R06-24 to the east may be a focal point for occupation. This is argued from having larger terraces, the only two food storage pits, the only two stone lined hearths, and containing on the unmodified slope just below these pits the only lithic work floor to be found in this dispersed settlement (Figure 5.21). The carved wooden panel thought to be from a whare hui or Māori meeting house [Point OBJID 118] was cached on a slope below the mid part of this settlement. It is unclear where the carved building was located, since the adjacent terraces of site R06-22 appear too small to have supported such a large building. The only sites at the southern end of the island with large enough terraces to do so are in R06-24 or R06-27. If our interpretation of R06-24 as a habitation site is correct then its 'noa' (profane) function would make it unsuited for such a 'tapu' (sacred) building. Only site R06-27 with its carving function and areas lacking midden, would have had the appropriate tapu status to support a carved meeting house.

To test these assumptions about site function and early settlement, an excavation was carried out on site R06-24 (see Chapter 5, Section II).

<u>Location Landing Site R06-29</u> The southern quarter of Tawhiti Rahi has a different topography to the remainder of the island. Unlike the high plateau with its encircling 100 m tall vertical cliffs that dominates the northern part of the island, the southern lowlands are more rounded, with moderate slopes that drop down to the west to a series of minor bays with cliffs varying in height from only 10 to 50 m. The largest of these minor bays in the southern lowlands is Camp Bay, formed by the sheltering arms of two headlands that form a 'horseshoe' shape facing west towards the mainland. Although there are upwards of three places in this bay that people can scramble ashore (Figure 5.21) it is site R06-29 that provides the least difficult access for people entering and exiting the island by boat.

This site is located on the southern side of Camp Bay and is bounded by the permanent stream to the north and to the South Garden (R06-28) to the north-east. To the south the island progressively narrows and steepens and no features or portable material culture have been found south of this landing site. Situated on a moderate to steep north facing vegetated slope, the last 10 m that drops down to the water lacks the vertical cliffs that characterise nearly all the coastline of Tawhiti Rahi. Instead there is only a moderately steep 30 m wide section of the rock face that descends down to the surface of the. With the addition of four steps cut into the steeper parts of the volcanic bedrock, this rock face can be walked up by people. It is unclear if these four cut steps are prehistoric or historic in origin.

<u>Description Landing Site R06-29</u> Site R06-29, also known as the western landing site, is located on the only reliable access to the island. Located on the western side of the island, it is sheltered from the prevailing easterly winds and sea swells. The low and sloping cliff face below this site has been modified to provide walking access up onto the gentler slopes of the site itself. Here on these moderate slopes there are a cluster of six terraces varying in size from 3 x 2 m to 12 x 8 m. Like some terraces in the interior, these have been built up at the front with stone retaining walls, but they have unique features in that all of them have been partially cut into the volcanic tuff slope. These terraces extend from 6 m above sea level to a point 60 m up the slope, and occasional obsidian artefacts have been recorded here. From these features a modern flagged (but not benched) track extends north along the contour and joins the line of the stream 150 m away where it exits into the bay via a small water fall. It is highly likely that this access line was also used in prehistory (Figure 5.21).

<u>Interpretation Landing Site R06-29</u> The encircling vertical cliffs around Tawhiti Rahi severely constrain access on to the island except for two places in the south. Although midden found at site R06-21 on the east coast in Rocklily Bay suggests that people have used this as an alternative landing site when the rare winds and swells from the west made landing on the east coast difficult (see geographical area 12 discussion), it is clear that terrace site R06-29 on the western coast in Camp Bay was the main access point for the islanders because it is only 10 m above the water, has been modified to provide easy walking access up onto the island, and it is well sheltered from the prevailing easterly wind and swell patterns. Supporting this premise is the fact that unlike the unmodified topography of Rocklily Bay, significant efforts have been made in Camp Bay to excavate the hill side and then construct the terraces that form this site. Because it provides the easiest and most reliable access point onto the island, it is argued that the archaeological features recorded here were deliberately constructed so that the inhabitants could facilitate and control access to the island.

Although the large lower terrace in site R06-19b on the north side of Camp Bay provides a canoe haul out point, site R06-29 on the south side is the only example of a constructed 'landing' site identified on the island, and this has led to it being classified as a specialist site. As such the use (though not necessarily in its existing form) of this unique access point is likely to be both early and to have been ongoing throughout the island's human history.

5.1.2.12 Geographic Area 12 - South-east Cliffs (R06/21, 26, 27 & 28), Figs 5.22 - 5.24

<u>Location</u> This area is found on the southern third of the island in the southern lowlands, south of the escarpment that leads up to the plateau. It differs from the northern plateau in having moderate slope on the western margin while the vertical cliffs along the east coast are at 80 m high significantly lower than the 160-180 m that is common around the plateau. Here a narrow cliff top ridge is located on the eastern edge of the island. Immediately to the east and south are vertical cliffs that form the east coast and to the north the narrowly separated vertical cliffs that make up the walls of Rocklily Bay. West of the eastern cliff top ridge is a moderately gentle slope that drops down to the permanently flowing South (Charles) Stream that drains this southern catchment into Camp Bay.

<u>Description Eastern Landing Site R06-21</u> This site is located on the eastern side of the island in Rocklily Bay and is found immediately above the high tide line among large boulders at the foot of the steep gully that leads up to the foot of the plateau escarpment(5.22). Unlike the western landing site (R06-29) in Camp Bay, this site contains no visible earth or stone work features. Instead the archaeological connection comes solely from the faunal material recorded here by previous visitors. This material is all shell fish and includes rocky shore species such as whelk that can be locally sourced, as well as pipi that must have been imported from some sandy shore environment not found on the Poor Knights Islands.

<u>Interpretation Eastern Landing Site R06-21</u> Despite the lack of archaeological structures among the large boulders at the base of Rocklily Bay and the difficulty and time needed to climb the steep and (currently) unstable gully that rises up to the high eastern cliff top, Rocklily Bay has been interpreted by Lawlor (1979) as a safe landing place that provided access to the island. Having used it for this purpose during the 2006 field season when rare easterly swells made landing on the easier west coast too difficult, it is confirmed as a viable landing option, but when compared to the western landing site (R06-29) it is one that requires significantly more effort to carry gear up the 100 m high scree gully to get onto the island proper. When the predominant easterly wind is blowing, the ocean swell runs straight into this narrow bay making it unusable for landing. Therefore this landing must be considered to be only a bad weather alternative to the primary landing point in the western Cave Bay (R06-29).

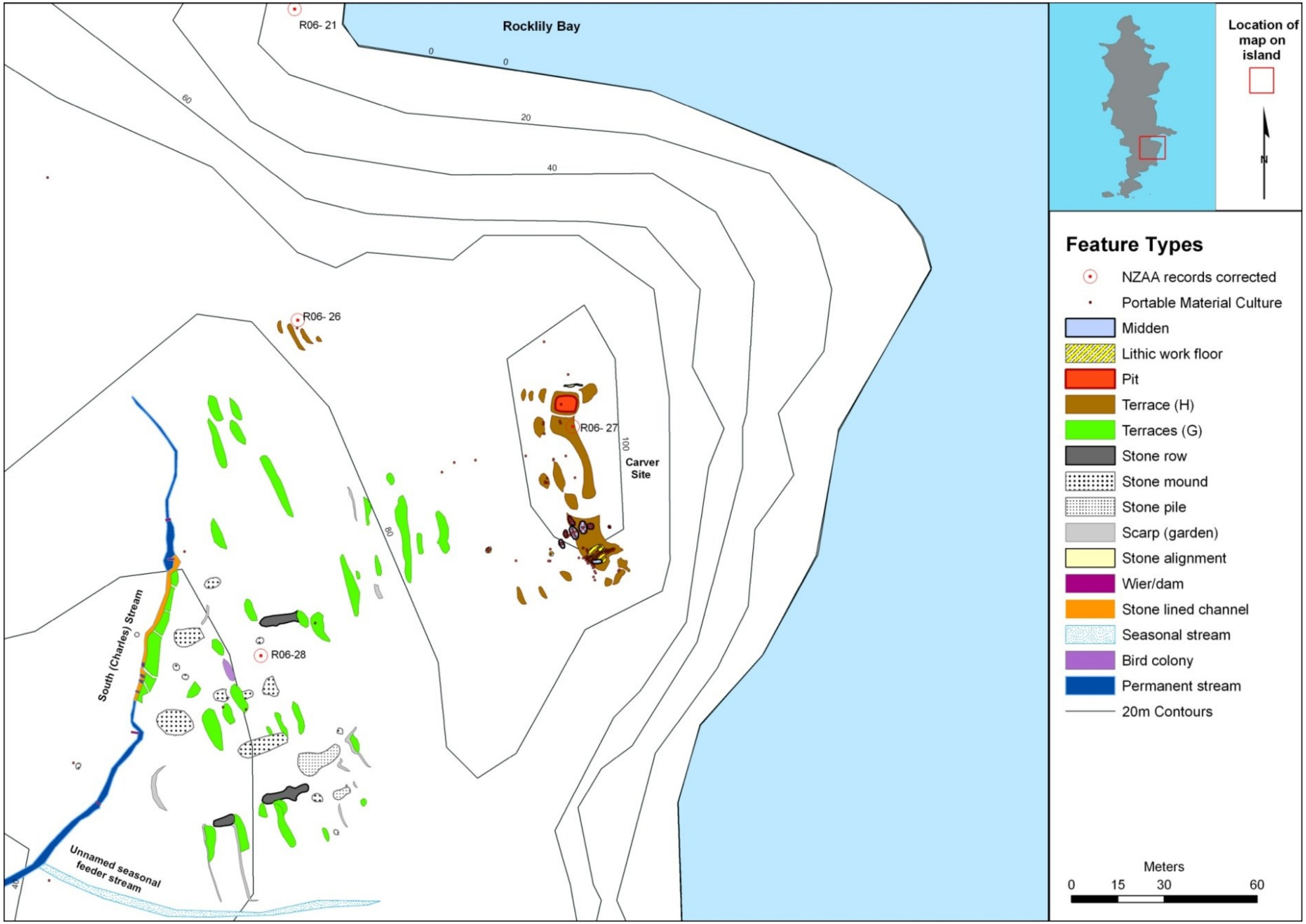


Figure 5.22 Geographic Area 12 - South-east Cliffs (R06/21, 26, 27 & 28).

Description R06-26 & Carver Site R06-27 These two sites are physically separated from other sites located in the southern lowlands. Since there is no structural reason to separate them from each other, they are now considered to be a single site that is referred to as R06-27(Figures 5.22 and 5.23). Bounded by vertical cliffs to the north, east and south, the archaeological features are clustered along the eastern cliff top ridge and the upper western slopes of the South Stream catchment in a 40 m east-west and 70 m north-south area between the eastern end of Rocklily Bay and an un-named minor bay which indents the coast to the south. The features recorded are dominated by 17 habitation terraces, some with stone alignments and one food storage pit. It is rich in portable material culture (Table 5.3). This is especially so at its southern end where four stone adzes, red ochre, one water rolled pebble and over 200 obsidian artefacts were recorded both as a general scatter and also as a lithic work floor. Faunal material recovered from seven small, discrete areas at the southern end of the site includes shell fish, fishbone and bird bone (see Chapter 5 Section III). Scattered human remains located on the ground surface include a tibia that appears dog chewed (Taylor pers. comm 2005), one mandible and one loose tooth. These most likely relate to fatalities associated with the 1823 attack. A summary of the site specific portable material culture and human remains identified are set out in table 5.3 below. An island wide analysis of portable material culture and of human remains encountered is given in Chapter 5 Section III.

Table 5.3 Portable material culture and human remains.

Carver site R06-27	Portable material culture	Number
Lithics	Adze/adze fragments	7
	Obsidian flakes - imported	189
	Obsidian cores - imported	19
	White silicified rock - local	11
	Hammer stones	6
Bone	Bird	2
	dog	1
	fish	2*
Paint	ochre	5
Shell	Sandy shore species	10
	Rocky shore species	16
	Land snails - Placostylus hoongi	6
Human remains		3
TOTAL		**117**

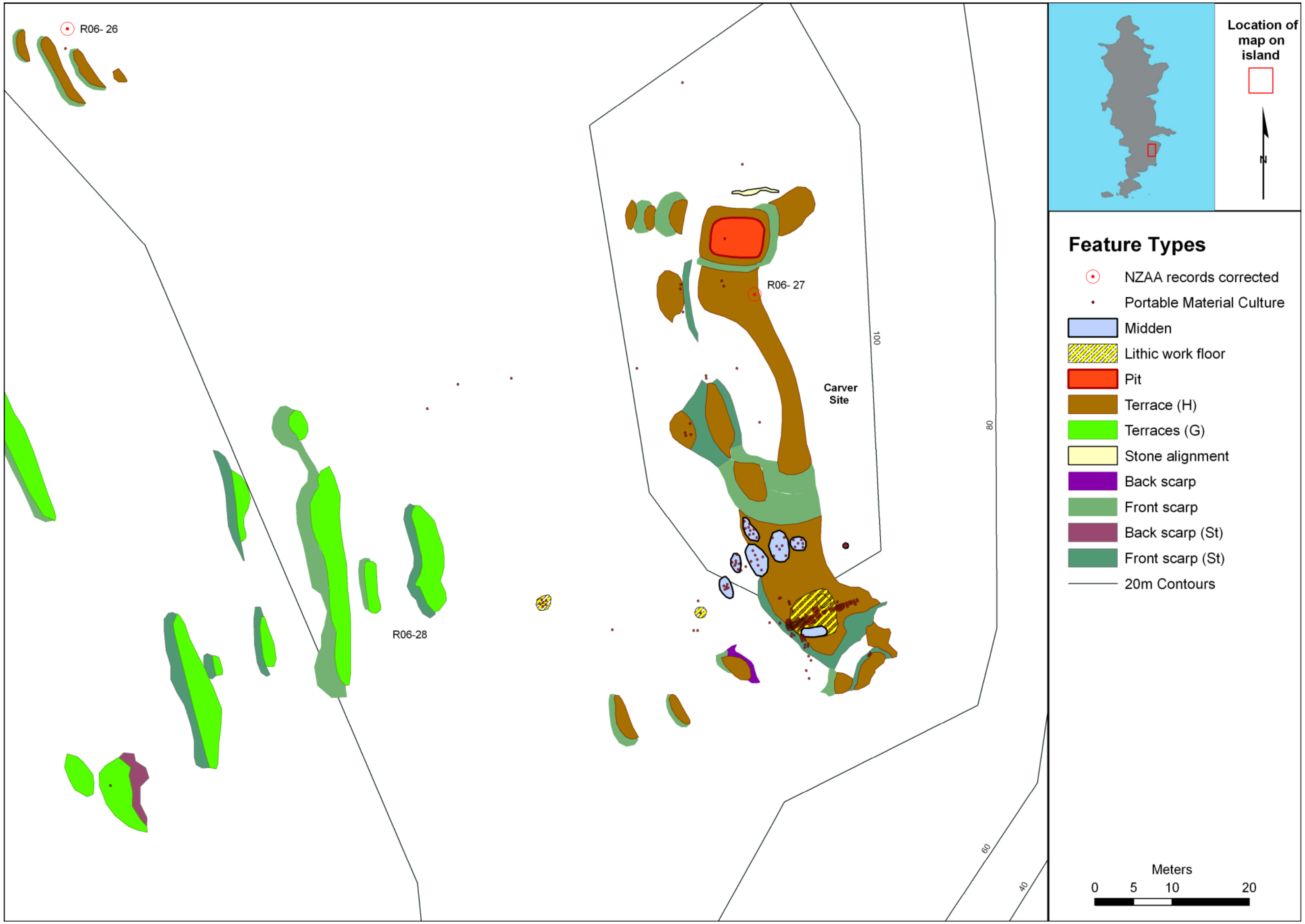


Figure 5.23 Geographic area 12 - Carver site R06-27 enlargement in South-east Cliffs.

Interpretation R06-26 & Carver Site R06-27 This ridge top cluster of features previously recorded as sites R06-26 & 27is a rare site type due in part to its physical separation from other settlements and gardens found in the southern lowland part of this island. Further it has a unique blend of artefacts and structures which include one of the largest lithic work floors found and four adzes - the largest number so far found on the island. This was interpreted as a specialist stone working site by Tohunga Whakairo (Expert in carving) Te Warihi Hetaraka who visited the site on multiple occasions. He suggested that the blunted adzes recovered were waiting to be re-sharpened and that together with the adjacent obsidian concentration this identified the site to him as the residence and workshop of a Tohunga Whakairo. General discussion with other senior Ngatiwai kaumatua (elders) suggested that living here in a place physically isolated from other settlements in the southern lowlands would have been necessary due to the tapu (sacred) nature of master carvers who would (like Te Warihi Hetaraka today) be a Tohunga Whakairo. This term can be interpreted as a master caver with spiritual as well as physical responsibilities to his community. It is interesting that this cultural interpretation of site function was made some years prior to the discovery of a carved panel on the adjacent dispersed settlement. The rare presence of human bone in a non-burial context suggests that at least one individual was killed and left here during the 1823 attack. An analysis of the non-human bone is found in Appendix 7i and 7ii.

Description: South Garden R06-28 Located in the South stream catchment this site extends for 160 m north-south and 90 m west-east. It is bounded to the west by a north running section of the permanent stream itself and to the south by an east running ephemeral feeder stream (Figures 5.24). To the east and north these features extend up the east side of the stream catchment slopes but stop 30 m below site R06-27 on the coastal cliff top ridge.

The features in the stream bed differ in type from those found on the slopes and make up a small but unique part of this site. Here in a 100 m long by 2-6 m wide section of stream bed were found eight stone weirs/dams similar to features found on the Three Kings Islands in the Far North (Maingay, 2007). The gently sloping central 50 m section of this stream contains a rough stone lined channel that is modified with five of the eight weir/dams that cross it. There are six stream bed terraces on the adjacent east side that range from two to five meters wide and five to 13 m long. These six terraces descend the stream bed separated by low earth front scarps some of which are stone faced. Four of these five weir/dams, cluster at the southern downstream end of the stone lined channel where the stream starts to steepen. Of the remaining three weir/dams,

Figure 5.24 Geographic Area 12 - East Garden site R06-28 wetland garden enlargement in South-east Cliffs.

one is found upstream and two downstream from the area of stone lined channel. Immediately below each of these three weir/dams the stream widens noticeably for 3 to 6 m. Probing of the stream bed in. these wider areas (that are currently full of silt) suggest that there are bowls or depressions in front of each dam that are consistently deeper than the other parts of the stream. No portable material culture was noted in or on the banks of this 100 m long section of stream.

The moderate slope that rises up to the east from the stream contain most of the features in this site, namely nine stone faced scarps, 12 stone mounds, two stone piles, three stone rows and 33 terraces. The terraces tend to be long but narrow ranging from 10-20 m long and 2-5 m wide. Only four portable material culture items were found here in the form of two whelk shells and two flakes of obsidian. The steeper east facing slopes west of the stream contain only two isolated stone mounds, one of which is built on a garden scarp and one fragment of fire cracked rock.

<u>Interpretation South Garden R06-28</u> All the features associated with site R06-28 in both the South Stream bed and on the adjacent slopes are interpreted as gardens. In the stream bed some garden features appear to relate to water conservation, collection and aeration through the use of man-modified ‘bowls’ below eight man made stone weirs or dams. The terraces and stone lined drains adjacent to the stream bed relate to these water management features and so are interpreted here as river-side plots where moisture and nutrient levels can be maintained for long periods (H. Leach 1976:118), most likely associated with the cultivation of taro (*Colocasia esculenta*). The more extensive stone structures and terrace features on the slopes between the stream and the ridge top specialist site to the east (R06-27) are similar to features found in the other five garden areas and are interpreted as dry land gardens associated with the growing of kumara (sweet potato) and te hue (bottle gourd).

5.1.3 Interpretation of site areas

A complex archaeology of stone and earth structures has been recorded on Tawhiti Rahi. Recorded at the feature level, these show distinctive presence and absence patterns on the ground that relate both to function and to the island’s topography. One of the key absence scenarios is the lack of any defended sites (Pa), and this is interpreted as being due to the island’s encircling vertical cliffs and very constrained landing sites that effectively make the whole island a pa and remove the necessity for human constructed defenses. Another absence is the lack of features in the central eastern area of the northern plateau. This can be explained by the differences in topography in that it is the only part of the plateau without the protection of a raised cliff top ridge. To the north and south this protecting ridge does exist and deflects strong winds over the top of the island, while in this central area the progressive slope allows salt laden air to significantly inhibit vegetation growth. Presence scenarios occur with the repeating appearance of patterns in the archaeological feature record. As discussed previously [5.1.1], there are only a small 'kit' of earth and stone structures that can be constructed by the islanders, so it is often the ratio of specific features and of specific portable material culture elements present within these patterns that indicate functionality.

Based on Lawlor's habitation, cultivation and burial model (Lawlor, 1988: 4), this new database of features and portable material culture collated in the GIS has been used to recognise four site areas of habitation, cultivation, specialist use and ceremonial use on Tawhiti Rahi (Figure 5.25). The following bullet points broadly define these site areas. Then the range of features and portable material culture that underpin this four part interpretation are summarised in Table 5.4.

Cultivation: Defined as an area used for horticulture.

- Found in sheltered localities, on gentle to moderate slopes and face to all points of the compass
- Involves clusters of small to large terraces as well as gently sloping stone-free ground assumed to be cleared for gardens
- Always associated with stone mounds and piles
- Not found in areas with unmodified loose stone on surface
- Stone rows are only found in gardens and often are located on outer boundaries
- May include food storage pits
- Can incorporate stone features such as revetted vertical retaining walls
- Not associated with midden
- Sometimes associated with occasional lithic artefacts
- Scatters of small stone as either remnant unmodified landscape, or deliberate placement as a lithic mulch

Habitation: Defined as an area used for settlement.

- Found on well drained slopes, ridges and cliff tops and face to all points of the compass and can incorporate individual as well as clusters of terraces
- Is often associated with artefacts and midden and cooking areas
- Not found amongst garden mounds but sometimes found immediately adjacent to them
- Is found in areas with unmodified loose stone on surface
- In general the terraces are smaller than terraces associated with gardens
- May include revetted walls
- Can be in close proximity to specialist food storage pits

Specialisation: Defined as an area with strategic or functional significance.

- Strategic significance e.g. a landing site controlling access to the island, refuge etc
- Functional significance e.g. cooking area, lithic work floor, food store, quarry
- It can incorporate individual as well as clusters of terraces
- Is often associated with artefacts. Only the rock shelter and some of the lithic work floors are associated with midden
- Not found amongst garden mounds but sometimes found immediately adjacent to them
- In general if terraces are present they are smaller than terraces associated with gardens
- May include minor structural elements like retaining walls, hearths, stone alignments and levelled floors

Ceremonial: Defined as an area with symbolic significance

- Symbolic significance e.g. high point/tapu area and specifically burials
- It can incorporate individual as well as clusters of terraces
- It can be associated with artefacts but never with midden
- Can include rare stone features like free standing revetted stone walls, stone alignments, revetted retaining walls terraces with raised stone
- Never associated with food storage pits or food debris

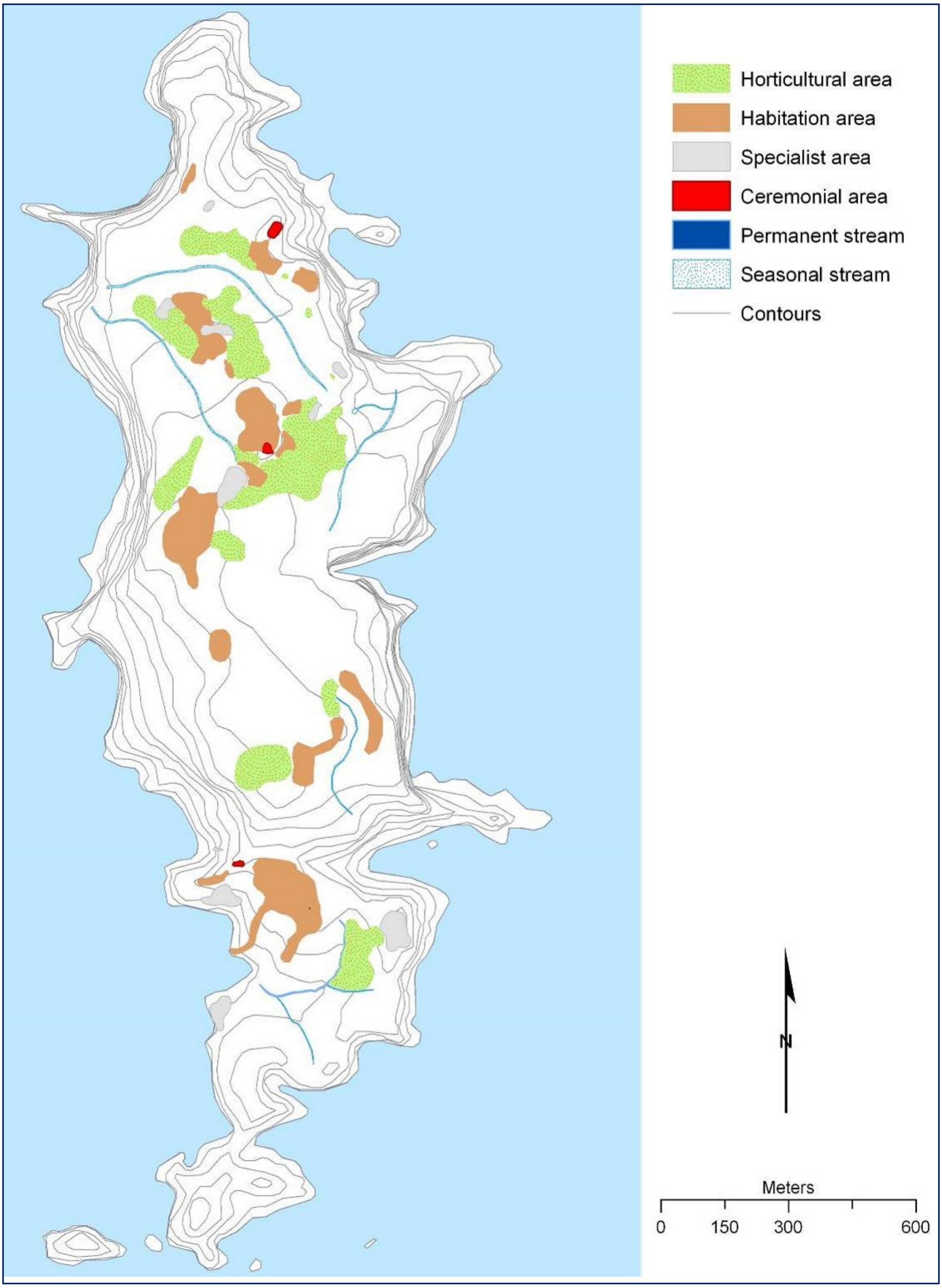


Figure 5.25 Four site areas found on Tawhiti Rahi Island

Table 5.4 Range of features and artefacts associated with four site areas.

AREAS	No.	FEATURE			ARTEFACT
		Aspect 1	Aspect 2	Aspect 3	
Habitation (cooking, sleeping)	442	Terrace (habitation)	Front scarp w/wt stone Back scarp w/wt stone	Rare hearths, occasional stone alignments	Obsidian isolates or scatter, Chert rare, occasional water rolled boulders (WRB)
	71	Stone mound	Regular shape	No soil amongst stone in mounds	Artefacts rare or absent
	2	Hearth	Stone lined on habitation terrace	In dispersed settlement only	Obsidian scatters, Charcoal, shellfish
	8	Stone pile	Result of village rock clearance	Irregular shape,	Artefacts rare or absent
	58	Stone alignment	Various size rock Various length	On terraces, on slopes	Artefacts rare or absent
	15	Cooking area, Open fires	On terraces or On gentle slope	Near habitation terraces	Obsidian concentrations, fire cracked rock (FCR), charcoal, shellfish, fishbone
	96	Find spots	Near terraces, track, cooking areas	Often associated with obsidian	Grindstone, adzes, hammer stones, WRB, bone, gourd seeds
	12	Midden	Surface. No stratigraphic depth		Dog bone, fish bone, shell
	82	Scarp (habitation)	Some faced with stone	Some without stone	Artefacts rare or absent
Cultivation	253	Scarp (garden)	Some faced with stone	Some without stone	Artefacts rare or absent
	368	Stone mound	Built. Stone, sometimes large rocks on outside perimeter	Some have stone /soil composition	Artefacts rare or absent
	84	Stone row	Built. Stone occasional large rocks on outside	Linear, run down slope	Artefacts rare or absent
	42	Stone pile	Result of garden rock clearance	Irregular shape,	Artefacts rare or absent
	5	Drain boundary	4 parallel trench's 8 m apart. Stone free area	1 assoc with weirs &wetland gardens	Artefacts absent
	185	Terrace (garden)	front scarp w/wt stone* back scarp w/wt stone*	Stream bed terraces	Artefacts rare or absent
	2	Small stone mulch	Within garden complex	2-5 cm diameter	Artefacts rare or absent
	11	Modified water course	dam / weir & stone lined channel	Cluster in 2 stream beds	Artefacts absent
Specialist	17	Lithic work floor	Adjacent to habitation terraces cooking areas		Obsidian concentration, adzes, red ochre
	1	Canoe terrace	40 m long, 10 m ASL above vertical cliff	Stone alignments	Scatters of obsidian
	2	Landing	West coast. Tuff cut terraces primary acc	East coast. Sec acc. No features	Occasional artefacts
	12	Pit	Dug into processing terrace or platform		No obsidian when in use
	1	Rock shelter	Open fires, levelled surface	Front scarp stone. WRB** alignment	Obsidian concentrations Charcoal, shellfish, WRB, fishbone, bone pig, adzed wood, gourd seeds ***.
Ceremonial	2	burial	High places, small terraces some with stone rim. Crypt & burial	Assoc with free standing stone wall	Human bone, 'canoe' burials with worked wood, no food debris, no obsidian

* Some stone scarps may have remnant near vertical revetted sections.
** WRB is water- rolled boulder.
*** See excavation section

The cultivation, habitation, specialist and ceremonial site areas are now discussed.

<u>Cultivation</u> The volcanic silt soils of Tawhiti Rahiare well drained and of low to moderate fertility and are well suited to the requirements of kumara/sweet potato cultivation (Coleman, 1972). Many authors have discussed in depth the archaeology found on similar volcanic soils in the Auckland and Northland regions (Sullivan, 1972 & 1974 &ND; H. Leach, 1976; Veart, 1984; Bulmer, 1989; Sewell, 1994; Sutton et al, 2003, and many others). Sewell in particular looked at the archaeology and early historic accounts and argued that stone mounds, piles, rows, walls and enclosures are commonly associated with the cultivation of kumara (sweet potato), taro, hue (bottle gourd) and yam (Sewell, 1994). Experimental investigation has shown that not only was the land cleared of loose rock before gardening, but that many of the stone mounds associated with this clearance contained an internal soil matrix that would have provided optimal environments for a range of 'climbing' or vine type crops including hue (bottle gourd) (Coates, 1992). The 30 years of archaeological and historic research bookended by the archaeological and gardening overviews of H. Leach in 1976 and Furey in 2006, provides strong but indirect evidence that many of the stone structures built on the volcanic soils of Tawhiti Rahi are associated with the dry-land gardening of kumara (sweet potato) and hue (bottle gourd) (Davidson, 1984; H. Leach, 1976 &1984; Furey, 2006).

In the Pacific region, taro was the dominant crop in most Polynesian island societies due to its high calorific value and high productivity, especially when grown in wetland gardens (Bellwood, 1987; Handy et al, 1972). In most parts of New Zealand however, the cooler climate made the quick growing kumara the dominant crop at the expense of the slow growing and frost susceptible taro (Davidson, 1984). It is only in the warmer far northern areas of New Zealand thattaro remained as an important crop especially when grown in highly productive wetland environments. Archaeological evidence of such wetland systems consists primarily of excess water control systems in swamps and flood plains. These include flood control drains at Awanui and Motutangi in the Far North (Barber, 1984), at Tangonge Lake west of Kaitaia (NZAM photo 1950, run 1366-6), and Whangaruru Harbour on the east coast (NZAM 1968, compilation photo 1618). At Waipoua forest,excess water running down the slopes in the high rainfall area of the forest catchment may have been slowed by cross slope garden scarps (Figure 5.26). Recently, detailed drawings of stream modifications have been made on the ThreeKingsand the Poor Knights offshore islands (Figure 20 author in Maingay, 2007; Robinson, 2004). Here in very localised areas, a number of stone weirs have been constructed across streams on North-West Island and Tawhiti Rahi Island of a type similar to that reported in Hawaii (Handy et al, 1972:380). Along with stone scarps across the slope, these may well be techniques associated with

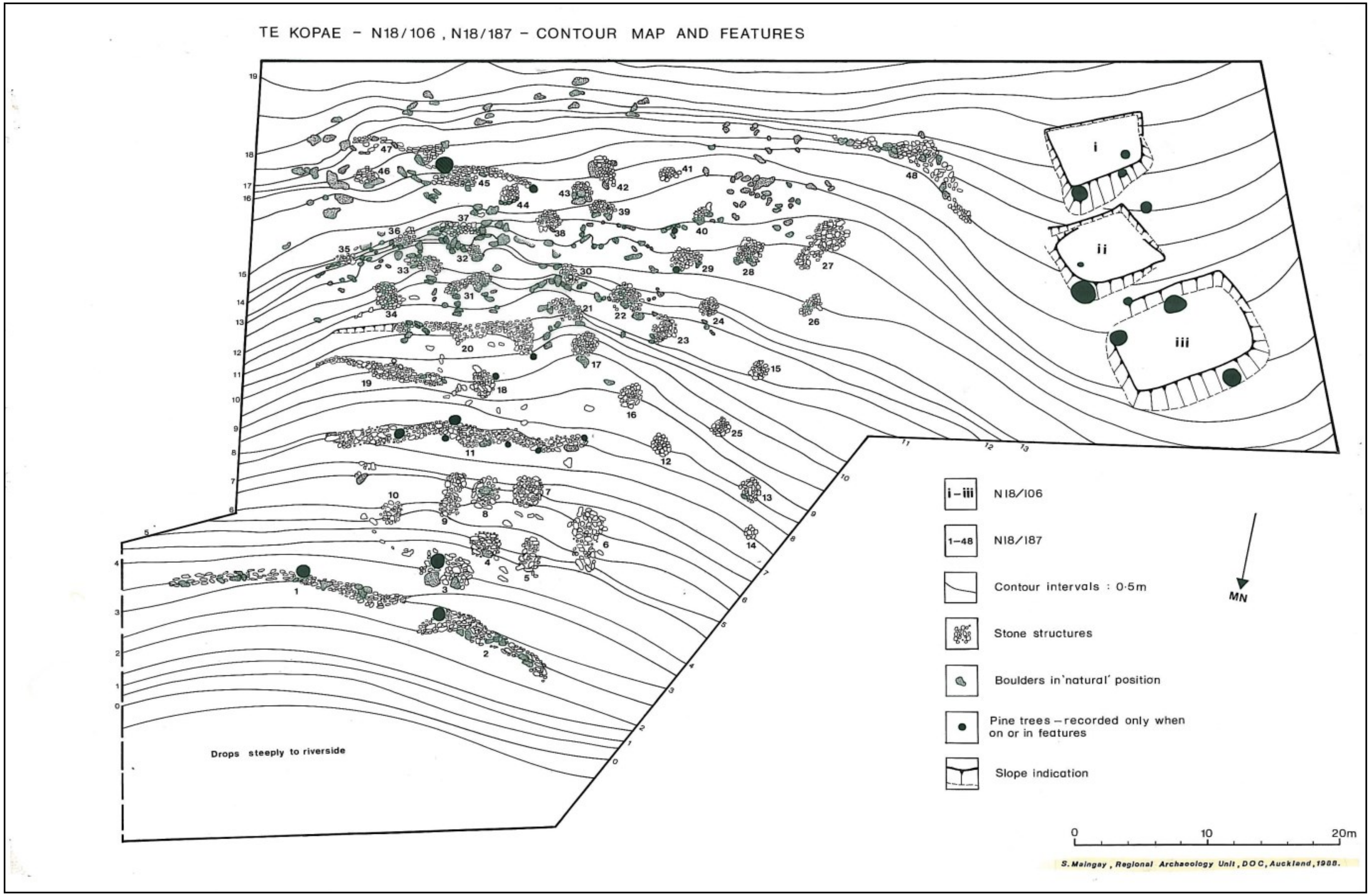


Figure 5.26 Te Kopae stone mounds Waipoua - N18/106 & 187(Smith, 1988). Stone mounds & garden scarps cluster to the east, while three terraces descend a ridge to the west. The down slope running stone rows found on Tawhiti Rahi Island are absent here.

water conservation in low or intermittent rainfall areas that would enhance all tuber production. The presence of terraces within the stream bed along part of the South (Charles) Stream on Tawhiti Rahi can however only have been used for the cultivation of specific crops that thrive in wet environments. The obvious plant to be grown here would be taro which is often still found in remnant patches in Northland streams (NZAA records, Matthews's pers. comm. 2004), however an alternative suggestion could see kumara tubers being planted here to speed up their 'shooting' before being transplanted into dry-land gardens (Robinson, 2004).

The field evidence from Tawhiti Rahi is therefore consistent with our general understanding of prehistoric wet and dry land horticulture in New Zealand (H. Leach, 1976; Sewell, 1994; Furey, 2006). It is argued that the repeating patterns of certain stone and earth feature types, the lack of portable material culture, and the location of such patterns within valley catchments clearly identify where Māori horticulture was occurring. It is likely from the soil types and ethnographic information that kumara was the dominant crop in these gardens but it remains unclear whether gardens continued into the historic period. It is also unclear to what extent any introduced European crops were used and if so, how these might have modified the prehistoric gardening systems.

Kirch argued that Hawaiian dry field garden systems with mounds, terraces as erosion-control systems and permanently defined plot boundaries, similar to those found on Tawhiti Rahi, were primarily used for kumara cultivation, and reflected an intensification from earlier shifting cultivation (Kirch, 1985:443). If a similar scenario is occurring in New Zealand then this must have occurred early in prehistory as pits, terraces, stone rows and elongated rectangular strip land divisions all have a long antiquity here (H. Leach, 1976:127, 132, 141; Welch, 2000). In the context of this thesis it is argued that both low productivity shifting cultivation and high productivity built gardens were both technologies imported from the Pacific and used on Tawhiti Rahi. The simpler shifting cultivation technology may have been applied first when populations were small and available garden areas numerous. Only later when populations were larger could the built gardens with their higher labour inputs be utilised. These differing technologies are not mutually exclusive or necessarily sequential. We do not however know when this change occurred and therefore the presence on Tawhiti Rahi of built gardens with complex structural elements does not engage meaningfully with dating the occupation of this island.

A consistent and ongoing problem in New Zealand archaeology is obtaining objective evidence confirming the presence of specific cultigens in gardens. The primary Polynesian cultigens grown in prehistoric New Zealand were tubers which, unlike seed producing crops like hue (bottle gourds), leave no preserved physical remains in the ground. Instead researchers must rely on ethnographic information (E. Best, 1976; H. Leach, 1976; Sullivan, ND) and early European accounts to inform us about how crops were grown, what types of soil were needed, and how landscapes were modified for gardening. In recent years starch grain, xylem cells and phytoliths studies have been made, that claim to directly identify introduced cultigens such as kumara, taro and native edible plants such as bracken (Horrocks et al , 2000; 2004; 2007a; 2007b;2008a; 2008b; 2011). However New Zealand still lacks a substantive database of indigenous plant phytoliths, xylem cells and starch grains against which known cultigen microfossils can be compared and shown to be unique. Until such a native plant database is created, this promising technique cannot be used to confirm that a given introduced plant isn't being confused with a native plant 'doppelgänger'.

An alternative method to directly identify individual cultigens is to use their DNA, which if successful will provide a unique 'finger print' of plant species. Currently there is no such method available, however soil samples from Tawhiti Rahi were sent to Landcare Research where an experimental DNA study is currently being carried out by Dr Jamie Woods. Dr Woods considered the circumscribed island environment and the known human history as providing a good control against which his cutting edge research could be compared. To date, the preferred methodology and the specific reactants required to identify the DNA of Māori or European cultigens has not been finalised, and therefore results of this study have not been included in this thesis.

Habitation

The dominant earth constructed structure found on the island is the terrace. Varying widely in size, terracescan occur on ridge tops and valley sides, as well as on the steeply indented southern lowlands. Occurring in both garden and occupation contexts, terraces reflect the broad need for a flat area of land for a functional purpose. The two types of terrace are not structurally different. Only terraces with structures built on them (like pits), or terraces containing clear evidence of faunal and floral material in a midden context, can be confirmed to have a habitation rather than a garden function. It is possible that some terraces can be attributed to a non-garden function from their size or location but if so, their specific use remains either unclear or has to be inferred from other factors.

Confirming the current interpretation of terraces as either gardens or habitation areas requires additional testing. One method that may prove useful is the measurement of phosphates in soils. Physical and chemical changes in soil can be induced by human occupation, and these changes are long lasting. Compared to unmodified soils and man-made gardens human occupation produces a distinctive soil chemical profile of three types of phosphate that has been utilised to indicate human presence (Eidt &Woods, 1974; Woods, 1977:251). Recent research has suggested that multiple factors are implicated in the increase or decrease of phosphorous in soil. Although the technique holds promise there is a need for more empirical data before specific interpretations of human/not human use or different types of human use can be confidently made (Holliday & Gartner, 2006). It is argued here that the circumscribed nature of Poor Knights Island archaeology might in the future provide an opportunity to collect such data due to the limited environment and cultural variables present. One such test would be to sample the 627 terraces for anthrosols. Finding reoccurring presence or absence patterns in the soil chemistry might allow the empirically designated gardens (188) and habitations (439) functions to be tested.

Specialist sites

A number of specialist sites were identified. These included a landing, a canoe haul out area, lithic work floors and food stores. For these sites, classification is based as much on the particular kit of stone and earth features present as on their location and size. In some cases, information gleaned from historic sources provides an interpretive hint. As such these 'specialist' designations will ultimately need to be tested through excavation as part of future research. The function of sites identified as pits can be more confidently determined.

Pit: A total of 12pits were located on Tawhiti Rahi during the survey process. Identified in the archaeological literature as the subsurface component of kumara storage structures (Davidson, 1984; H. Leach 1984), these pits are remarkable for their small number compared to the large hectareage of the gardens that they serviced. A possible explanation for this small number is that these 12 pits held only seed stock for the next year's planting, and the much larger volume of harvested cultigens were stored in impermanent above ground wooden structures (now long gone), or taken back to store on the mainland (see Chapter 3). Nine pits are located in the northern table lands and are in or adjacent to gardens. This is especially true for site R06-90 where three large pits have been dug into a single terrace [Feature OBJID 2528, 2529 & 2530]. Of the southern pits, one is associated with the specialist Carver site (R06-27) [Feature OBJID 116], while the other two with Hearth habitation site (R06-24) [Feature OBJID 2606& 2854]. One interpretation would have this north-south division relate to functional storage differences that we do not yet understand. Considering that taro and gourd were possibly grown on this island, the assumption that these pit sites relate only to kumara storage needs to be tested, hopefully through the future development of plant DNA studies.

Ceremonial sites

Pa or Urupa? There are three high points on the island that could have been topographically suited for defense. Despite arguments to the contrary by Haywood and Lawlor, there is no conclusive structural evidence that any of them were modified to become Māori pa (hill forts). The first of these is the Citadel (R06-18). Built on a knoll on a west descending ridge it has revetted walls, created by infilling between the vertically split columnar bed rock, to create terraces that led Hayward to say it was a pa. However the area of flat terraces contained within these defenses is extremely small and the knoll itself is overlooked by eastern part of the ridge that rises steeply to the plateau table land. Attackers using this ridge would negate any localised height advantage provided by the knoll to any purported defenders. The second large high points at Puketuaho (R06-12) have no wall features higher than 1 m. Even the Beacon site (R06-6), the third high point, with its 1-1.5 m high wall provides very little in the way of defense. It is argued here that the island did not need pa just like the Three Kings Islands in the Far North did not need pa. This is because they both have encircling vertical cliffs 10-180 m high that provided natural defense, turning the whole island into '…a natural pa' (Hetaraka, 2008). Able Tasman commented on this when passing the Three Kings Islands in 1643. He recorded that as his boats circumnavigated Manawatāwhi Island, the islanders kept pace, walking around the cliff top keeping an eye on any arrivals, and being ready with their weapons and height advantage to make any attack very costly (Heeres, 1893: 23-24, in Maingay, 2007). Even with the advent of firearms, any attacker would always be at a serious disadvantage as long as the defenders had muskets. Support for this 'no pa view' comes from site R06-29, the only practicable landing location on Tawhiti Rahi. If a pa was needed against external enemies then it should be located here, since this is the only location where attackers could expect to get onto the island, yet the features constructed here consist of six small terraces and no defensive wall structures.

Evidence that these high points were instead used as urupa (cemeteries) can be found at the Citadel (R06-19). At the highest part of this site is a rock overhang containing a cache burial of koiwi (bones). It is possible then that all three high points had an urupa function rather than a pa function. This theory will be tested by excavation in part II of this chapter.

5.1.4 Summary of Part I

With regard to the questions about who occupied this island, when, and why they do so, the archaeological survey has identified a landscape that is clearly Māori in origin but cannot identify who the settlers were or where they came from. As to why habitation occurred, the landscape clearly has a strong horticultural focus but does not inform us about the importance of other push factors such as marine or mutton-bird resources. The lack of any European influenced structural features implies a *terminus ante quem* for occupation to have occurred sometime late in New Zealand's prehistory or very early in the historic period, but the survey gives no insights into how long this settlement had been established.

Five sites were chosen for excavation to attempt to determine site function (the 'why' question), identify who the people were who built them and where they had come from (the 'who' question) and when this occurred (the 'when' question). The results of these excavations will be discussed in the section 5.2.

5.2 Part II: Excavation

The excavation of representative sites is the second component of the archaeological research program carried out on Tawhiti Rahi. As discussed in Part I, the survey of Tawhiti Rahi recorded an integrated archaeological landscape comprised of structural features and portable material culture. From this survey a group of key sites were selected for excavation to inform us in more detail about site function (the 'why' question), the people who built and used these sites (the 'who question) and to obtain carbon dates to determine a chronology of settlement (the 'when" question). A section 18 application was made to the then New Zealand Historic Places Trust, and an authority to excavate (Authority number 2005-265), was issued.

A total of five sites were chosen for excavation within the four broad categories of habitation, ceremonial, specialist and garden previously identified in the survey (Chapter 5 Part I). These are as follows:

5.2.1 Habitation:	Hearth site (R06-24 & 25)	Large area excavation & surface collection.
5.2.2 Ceremonial:	Puketuaho Hill (R06-12)	Limited trench and square excavation.
5.2.3 Specialist:	Cave Site (R06-17)	Limited trench and test square excavation and extensive surface collection.
5.2.4 Cultivation:	(i) North-east garden (R06-90)	Test pit investigation of a stone mound, terrace and stone row.
	(ii) East garden (R06-13)	Test pit investigation of a stone mound and stone row.

5.2.1 Habitation

5.2.1.1 Hearth Site R06-24 and R06-25

Located in the Southern Stream Valley geographic area 11, the dispersed settlement described in Chapter 5 Part I (R06/19-25) is in the southernlowlands of the island that overlook Camp Bay. It consists of 40 terraces scattered on three minor ridges that descend south-west towards Camp Bay from the saddle at the southern foot of the plateau escarpment. At the north-east corner of this settlement there is a cluster of features that include three large terraces with two rectangular stone edged hearths and two food storage pits (R06-24), and a lithic work floor (R06-25). Unlike the remainder of the dispersed settlement that extends west towards the Citadel (R06-18), and which is only associated with lithic portable material culture, this group of features is also associated with faunal and floral material (Figure 5.27). This north-eastern sub-group of the dispersed settlement is referred to from here on in as the 'Hearth site' and was selected for a series of excavations aimed at determining site function and chronology.

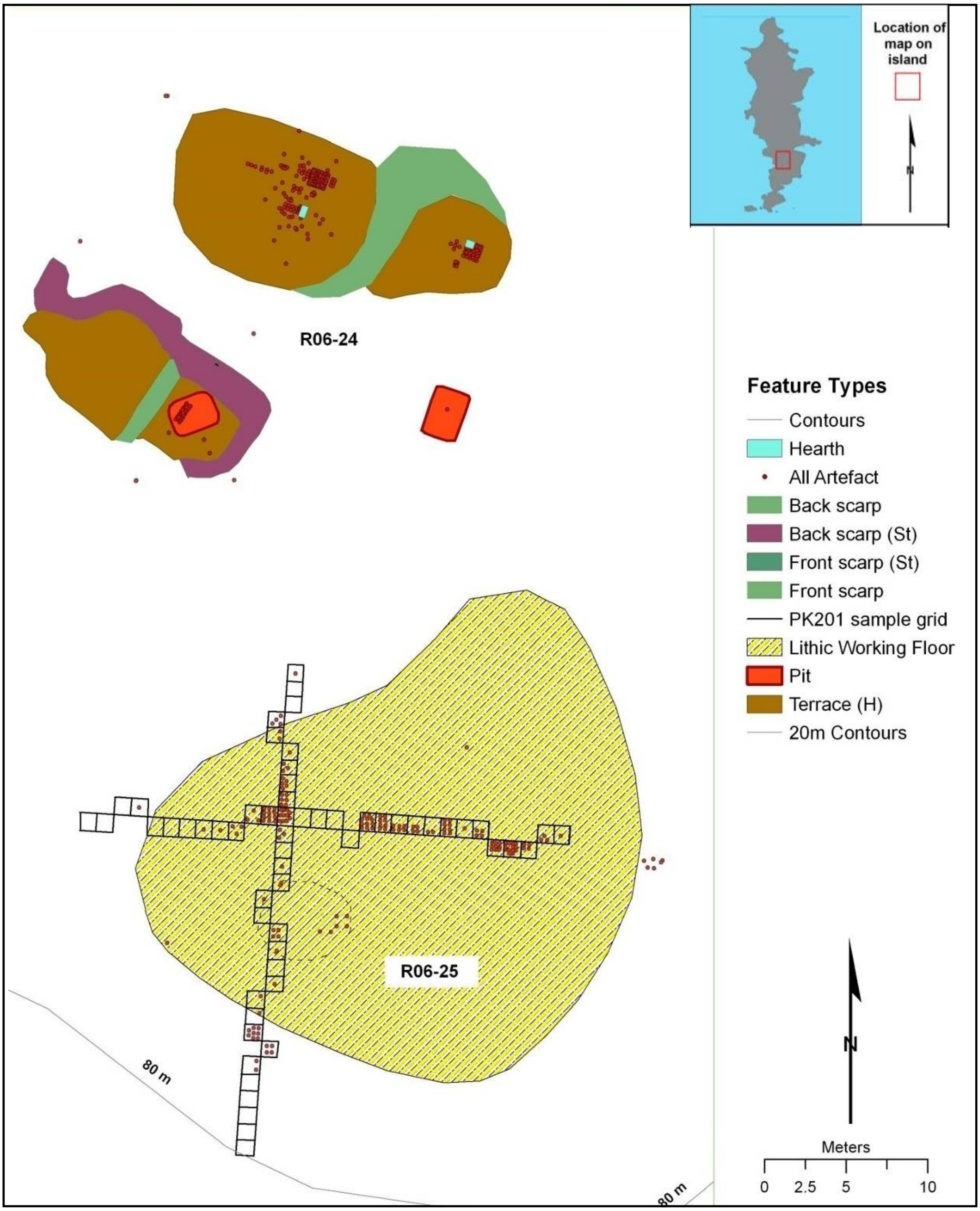


Figure 5.27 Habitation Hearth site R06-24 and lithic work floor site R06-25.

The excavation proper is focused on a near level area containing two stone edged hearths visible through the leaf litter, with extension southwards and eastwards onto terraces and a food storage pit(s). Portable material cultural recorded on the surface includes a small range of shellfish and fishbone and some occasional local volcanic rhyolite, but the most dominant material encountered was worked obsidian. For the most part it is found as a general low density scatter that extends over the gentle slope. However there is a high density concentration of obsidian found in an area of 30 x 30 m that contains hundreds of pieces of flaked obsidian (R06-25). The occasional presence of hand sized imported water rolled sinter hammer stones among this obsidian concentration suggests that this is a specialized lithic work floor. Together these features along with the portable material culture comprise the previously recorded sites R06-24 & R06-25.

The investigation was divided into four parts. Part 1 is referred to as the 'Large Terrace' and is centered on the larger of the two visible stone hearths on this upper terrace. Part 2 is found 20 m to the south and below this large terrace and consists of two small terraces referred to here as the 'Pit Site' for reasons which will become clear when the trench excavation is discussed later. Part 3 is a limited look at a smaller stone lined hearth located on another lower terrace 10 m to the east. Part 4 focuses on an investigation of the obsidian work floor (R06-25) located 25 m to the south-east of the large terrace on a very gentle slope. This was not excavated, but insteadgridded with one meter squares and extensively surface sampled and is referred to here as site 'R06-25'.

The methodology followed was to first identify all portable material culture on the unmodified surface defined here as lithics, fauna and flora. This material was then bagged, numbered and recorded in the accession register. Excavation (in Parts 1, 2 and 3 only) began by using 5 cm spits until a confirmed surface was identified. Once identified, these natural or cultural surfaces were then followed and any features found were given a unique number in the excavation notebooks. All features were half sectioned or wholly excavated and then plotted on to the primary site plan. All excavated portable cultural material was bagged after either sieving through a 3.2 mm sieve or being collected as a whole sample. Overall location and description information was written up in the excavator's field books so that all features and all portable material culture data could be entered into the GIS database as polygon and point data once field work was completed.

Each of the above four named parts to the Hearth site will now be described and the investigation results discussed.

Part 1. Large Terrace

An area of 10 x 10 m on the large terrace was cleared of vegetation and a permanent datum established at the northern (uphill) end. A north-south base line was set up running southward from the datum 6 m and a 6 x 6 m grid of 1 m squares was strung up to the west and east of this. Surface scatters of lithic and faunal portable material culture visible within this grid were plotted, bagged, and recorded into the accession register. The only visible feature, a rectangular stone edged hearth measuring 80 x 50 cm, was drawn onto the site plan. Excavation was initially focused on a 3 x 2 m area (E38-40, N42-43) in the centre of the grid,however as the dig progressed this was extended to include a 2 x 1 m to the west (E35, N41-42) and a 1.5 x 1 m area to the south over hearth feature 1 (E39-40, N41). These will be discussed separately within this larger terrace investigation as the 'Central Area', 'Stone Lined Hearth', and 'Western Area'.

Central area

A total of 12 square meters was opened up in the central part of Hearth 1. The stratigraphy encountered consisted of shallow 15-25 cm deep silty dark brown volcanic loam topsoil. Under this was found a mosaic of orange/brown soft clumpy ash and very hard compacted white ash. A 4 m long line of 9 post hole features that runs across the gentle slope had been cut into this concreted white ash. These posthole features were clearly visible in the underlying concreted white ash sub soil. They were not visible in the overlying topsoil of the Hearth 1 excavation area.

99 individual examples of lithic and faunal portable material culture were found both scattered throughout the topsoil horizon and in one concentration. This concentration is located at E40 N43 (Table 5.5). Lithic material encountered included the occasional imported Onerahi chert and sinter hammer stones, as well as occasional fire cracked fragments of locally sourced rhyolitic volcanic rock. However the bulk of the lithic assemblage was obsidian. By contrast, faunal material was sparse, lacked any fish bone, and consisted of only the occasional rocky shore shell fish midden.

Comment

The stratigraphy of the central area consists of a surface humic layer, over a silty brown topsoil of various depths that overlies a mosaic of orange/brown soft clumpy ash and compact hard white ash subsoil. The softer material was formed from the erosion and weathering of the parent rhyolitic lava rock while the harderwhite material was created by air fall deposits of volcanic ash. This white ash has accumulated in various places and in varying depths due to post-depositional transportation by ground water (Plate 5.17). The pattern of 10 post holes visible in figure 5.28 clearly shows that people built structures of some form on this site, but these structures are only archaeologically visible when post holes were cut through the hard compacted white ash layer. It is argued that the lack of any such features in the upper topsoil or in the softer orange/brown subsoil is due to long term bird burrowing following the human abandonmentof the island. Only features cut into the concreted white ash have survived the bird bio-turbation.

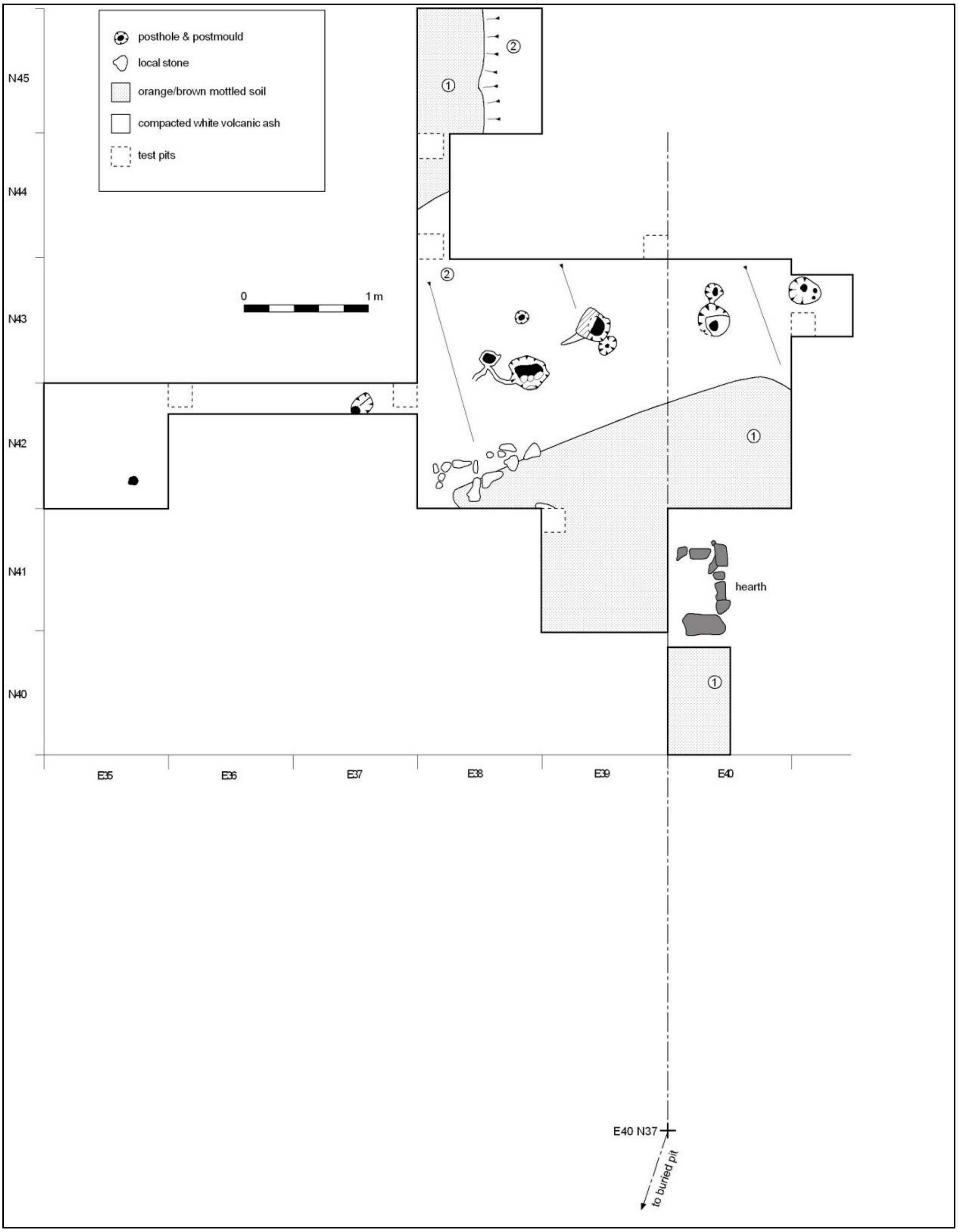


Figure 5.28 Hearth site R06-24. Area excavated at Hearth 1 showing the larger of the two stone lined hearths and a series of ten post holes in the white compact ash layer.

Table 5.5 Portable material culture excavated from R06-24, central area square E40 N43.[Feature OBJ ID 2602]

Depth	**0**	**0-5**	**5-10**	**10-15**	**15-20**	**20-25**	**25-30 cm**	
Lithics								
Obsidian	3	5	4	16	12		1	**41**
Rhyolitic tuff	1	5	2	1		1		**10**
Siliceous tuff	3	4	3		2	1		**13**
Breccia		2	2					**4**
Red ochre		1	2(1**)			1**		**4**
Chert		2	2	3	1	2		**10**
(water rolled)		1	3		2			**6**
Unidentified rock		2(1**)			1**	1		**4**
Faunal								
Rocky shore		2		1				**3**
Sandy shore								
Unidentified shell								
Fish bone								
Bird bone								
Floral								
Charcoal	1**		1**		1**	1**		**4**
Seeds								
TOTAL	**8**	**24**	**19**	**21**	**19**	**7**	**1**	**99**

* Refers to material that has been burnt ** Refers to scatters

Plate 5.17 Hearth site R06-24. A 3 x 2 m square excavated in at grid E38-50, N41.5-42.5 looking east. One excavated and two unexcavated postholes are visible in the hard white ash to the north while soft orange material is visible to the south. Stone lined hearth 1 is visible between the larger and smaller excavation squares. [036-9 Walter 2005]

Apart from a scatter of fishbone and shell fish fauna, the portable material culture in this part of site R06-24 is mostly a lithics assemblage. In particular there is a clear focus on flake tool production as shown by the presence of sinter hammer stones, occasional chert flakes and a large number of obsidian flakes. The presence of this flaking assemblage throughout the undifferentiated stratigraphy is attributed to disturbance by burrowing sea birds. As such the function of the central area is interpreted as a minor lithic work floor with a particular focus on square E40 N43 that might represent a singular knapping event or a preferred knapping location. The disturbed stratigraphy makes it impossible to find an intact floor, so it is currently unclear whether these knapping activities were occurring inside or outside of a structure. The postholes visible in places in the patchy concreted white ash clearly form a line and may be part of a fence or a wall. However from the available spatial evidence it is not possible to interpret whether this linear structure was part of a more complex structure such as a house.

Stone Lined Hearth Feature 1

Located at E40.1-40.5 and North 40.9-41.7 this 40 x 80 cm three sided alignment of nine pieces of silicified tuff was the only feature of this site visible on the unexcavated ground surface. Once the top 5 cm was excavated it was possible to see that large north rock had collapsed outwards and that most of the other rocks had been broken in-situ. If the stones were restored to their original position, the interior of the hearth would measure about 40 x 40 cm (Plate 5.18). The total area enclosed by these rocks was excavated in 5 cm spits with the topsoil occurring from 0-5 cm (spit 1). Then the remaining fill was excavated in spits 2, 3 and 4 (5-10, 10-15, and 15-20 cm) with all material removed being passed through a 3.2 mm sieve so as to collect lithics, shell, bone and any other cultural items of interest. The sieved residue was bagged for future analysis. Spits 5 and 6 (20-30 cm) had all large shell and lithics removed and then were total sampled. The material culture in the hearth contained a mix of lithics and fauna along with charcoal (Table 5.6). Although material was recovered down to 30 cm, the bulk of the portable material culture was found in the top 10 cm.

The area immediately west of the open side of the stone lined hearth at E39 N41 could relate to the use of this fire if the opening was deliberately made. Excavation of this adjacent material recovered portable material culture dominated by fauna that includes fishbone as well as rocky and sandy shore shell fish. Lithic material was limited to a small amount of obsidian shatter and some fire cracked local rhyolitic rock (Table 5.7). All of this material was located either on or in layer1 (0-3 cm) and down onto the top of layer 2 (3-5 cm).

Plate 5.18 Hearth site R06-24. Stone hearth located in R06-24[Feature OBJ ID 2811], grid E40.1-40.5and North 40.9-41.7 [Walter 2005 IMG_3857]

Table 5.6 Hearth site R06-24. Portable material culture excavated from stone hearth 1 at square E40 N41.[Feature OBJ ID 2811]

Depth in cm	**surface**	**0-5**	**5-10**	**10-15**	**15-20**	**20-25**	**25-30**	
Lithics								
Obsidian		2	1					3
Rhyolitic tuff			2 (1*)			1		3
Siliceous tuff		4	2 (1*)					6
Breccia			1*			1		2
Red ochre		1	1					2
Unidentified rock							1	1
Rocky shore		1		1				2
Sandy shore		1	1		1	1		4
Unidentified shell							1	1
Fish bone		1						1
Bird bone		1						1
Charcoal		1	1					2
Seeds							1	1
TOTAL		**12**	**9**	**1**	**1**	**3**	**3**	29

Table 5.7 Hearth site R06-24. Portable material culture excavated west of hearth 1 at square E39 N41.[Feature OBJ ID 2602]

Depth in cm	**surface**	**0-5**	**5-10**	**10-15**	**15-20**	**20-25**	**25-30**	
Lithics								
Obsidian	1	2**						**3**
Rhyolitic tuff		4						**4**
Siliceous tuff								
Breccia								
Red ochre								
Unidentified rock								
Rocky shore	1	2						**3**
Sandy shore	1	1						**2**
Unidentified shell								
Fish bone		1**						**1**
Bird bone								
Charcoal		1						**1**
Seeds								
TOTAL	**3**	**11**						**14**

* Refers to material that has been burnt ** Refers to scatters

Comment:

This hearth is associated with some form of habitation structure (Figure 5.28). The stratigraphy found in the stone lined hearth in the central area is simple, with 5 cm of black humic topsoil above 25 cm of undifferentiated dark grey ashy fill soil. This overlies a pink/white volcanic ash subsoil. Portable material culture found here includes lithic, fauna and flora mostly in the top two spits. The lithics are dominated by a range of local rhyolitic tuff and breccias as well as occasional imported obsidian & one red ochre sample. Fauna located includes rocky and sandy shore shell fish as well as fish and bird bone. Flora is limited to charcoal and unidentified seeds.

A pattern in the portable material culture data is visible in the stone lined hearth found at E40 N41. This shows fish and bird bone as only being found in the first spit (0-5 cm), while charcoal, burnt local volcanic rock and obsidian are only found in the top two spits (0-10 cm). This pattern is repeated in square E39N41 located west of the hearth and suggests that food preparation and/or consumption was occurring at these adjacent squares at the same time. Much of the material culture recovered is potentially local in origin, however the sandy shore shellfish and the obsidian must have been imported. Unlike much of the rest of this site, the stratigraphy here does not appear to have been significantly disturbed by burrowing sea birds. If this is a correct interpretation, then the dominance of material in the top 5 cm implies an increase in cultural activity late in the occupation sequence.

Western Area

To investigate the general stratigraphy of the area, a 20 x 20 cm test pit was dug 4 meters west of the stone lined hearth on the large terrace. Located within the square E35 N42, this small test pit was quickly expanded to a full 1 x 1 m and eventually reached a depth in excess of 1 m. The section photograph (Plate 5.19) shows that the natural sub-soils varied extensively in both texture and colour, while the cultural horizon above this was quite simple. This top cultural layer consisted of 0-20 to 0-40 cm of a dark charcoal stained soil with at least two obsidian artefacts. Under this topsoil, at least one post/stake hole that had been cut into it the compact ash subsoil is visible [grid E35.7 N42.3] (Figure 5.28). The subsoil consisted of a complex of natural layers including very compact white ash, very compact white and slightly brown mottled ash, light brown and white soft mottled ash, and a mid-dark brown soft fine grained soil. This later fine grained brown soil was initially interpreted as a cultural feature however extensive excavation of the white ash down to a depth of over 1.3 m suggested it was natural in origin.

Plate 5.19: Hearth site R06-24. Natural white volcanic ash, looking east at grid E35, N42. Two possible postholes are visible in section in the east baulk. [Walter 20053884]

Comment:

A small single post or stake hole is visible in plan view (Figure 5.27) and two probable post holes appear in section along the eastern baulk (Plate 5.19). These appears to be part of an alignment of 10 holes that runs across the back of this terrace site, and which has been cut into the compacted white ash. The scarcity of lithic material (two obsidian flakes only) and the absence of any faunal material recovered suggests that this square is on the western periphery of the Hearth habitation site that is centered on the area E37-42, N41-43. The key result from this excavation is an understanding that the white ash which forms part of the natural subsoil has a very deep profile – in places going down 1.3 m+.

Part 2. Hearth Feature 2

This site is located ten meters to the east of stone lined hearth 1. It consists of a smaller and lower terrace measuring 9 m north-south and 3 m west-east, and a sunken depression on the gently sloping ridge immediately to the south of theterrace (Figure 5.27). A second stone lined hearth is visible at the back of this terrace.

Stone lined hearth 2

The visible surface features of hearth 2 are two large slabs of silicified tuff laid on edge on the western and northern sides. These rocks measure 30 and 45 cm long and would once have enclosed a 40 x 35 cm fire place. The excavation began with digging a 20 x 20 cm test pit in the north-west corner of this fireplace where the two hearth stones come together. Then a 1 x 1 m area that encompassed the hearth and this test pit was strung up and excavated in 5 cm spits. This test pit excavation showed the visible hearth stones to extend down 30 cm into the ground. Also fire cracked fragments of this rock type were found below the ground surface to the south and east, in a position that suggests the hearth once had four sides.

Comment

The stratigraphy revealed in this test pit lacked the humic topsoil found elsewhere on this terrace. Instead the first layer consists of 0-10 cm of dark topsoil that contained nearly all the lithic, flora and fauna artefacts recovered from the excavation of stone lined hearth 2. Layer 2 beneath this extends from10 to 20 cm deep and consists of a lighter brown soil formed from the mixing of the darker topsoil above and the lighter and more compact clay/ash subsoil below. As such it is not surprising that the soil in Layer 2 gets progressively lighter the deeper it was removed and contains non-cultural rhyolitic rocks. Layer 3 extends from 20 cm to an unknown depth and is a compact yellow/white clay/ash subsoil very similar to that found in Hearth 1 to the west.

Portable material culture located within hearth 2 includes lithic, fauna and flora with lithics dominating the assemblage. Most of the material was found in spit 1 (0-5 cm), however obsidian and sandy shore shell fish were found in all four spits (Table 5.8). The lithics are nearly all imported obsidian (34) along with single examples of rhyolitic tuff, red ochre and an unidentified rock. Two artefacts were identified from spit 1 and included a chip from a stone adze's cutting blade [Point OBJ-1335] and a broken stone tool that is either a fine grained sandstone file or part of a small chisel [Point OBJ-1110]. A small unmodified chert or sinter pebble made up the remainder of the lithics [Point OBJ-1418]. Faunal material consisted of occasional sandy shore shell fish (5) from spits one through to four, some fishbone (2) in spits one and two, and a Placostylus shell (1) in spit 2. Floral material was limited to one piece of charcoal (1) in spit 1.A small amount of portable material culture was also recovered from three other localities within 10 m of the stone lined hearth (Table 5.9). When compared to the material culture found in hearth 2, this material shows a similar pattern of sandy shore shellfish and imported obsidian. The only difference is the presence of two rocky shore shell fish [Point OBJ 1341 & 1346].

The material culture found in the stone lined hearth 2and within a two meter radius is similar to that found in and west of hearth 1. It is likely then that food preparation and/or consumption of local fish as well as local and imported shell fish was occurring here. The presence of imported lithics in the form of flaked obsidian (but no hammer stones), a single basalt adze flake and a single broken chisel/file fragment are most likely associated with some form of generalised habitation occurring in or adjacent to this stone lined hearth 2. Like stone lined hearth 1 to the west, it does not appear to have been significantly disturbed by burrowing sea birds. If correct and the stratigraphy is intact, then the dominance of material into the top 5 cm implies an increase in cultural activity late in the occupation sequence. The similarity in the types of obsidian found in both hearths (see Chapter 5 Part III) suggests occupation was contemporaneous.

Sunken depression [Hearth 1 grid E51.7-53.8, N31.3-34-8]

The ground to the south of the terrace containing the second stone lined hearth drops gently for 14 m before falling steeply away. The lower four meters of this gentle slope drops to the south and to the south-west. Cut into this slope is a level sunken feature approximately 3.5 x 2 m in size which is bounded by small vertical scarps on the north, west and south sides. The southern end of this level feature coincides with the start of the steep southern slope. Surface artefacts recovered from this feature were limited to a single obsidian flake [Point OBJ 1131] (Table 5.9). A small 20 x 20 cm test pit was dug 30 cm deep into the centre of this feature [Grid E33.3 N52.7] and a total sample was taken (Bags 399 & 400). Examination of the section showed a 10 cm black humic topsoil over a 15-25 cm thick medium brown friable soil with no features orother layers present. No artefacts were identified in the excavatedmaterial.

Table 5.8 Hearth site R06-24. Portable material culture excavated from Hearth 2 at square E53.3 N43.3.[Feature OBJ ID 2607]

Depth in cm	surface	0-5	5-10	10-15	15-20	20-25	25-30	
Lithics								
Obsidian	6	9	9	6	4			**34**
Rhyolitic tuff		1	1		1			**3**
Siliceous tuff				2				**2**
Breccia								
Red ochre		1						**1**
Chert								
(water rolled)								
Unidentified rock		1						**1**
Artefact		2						**2**
Fauna								
Rocky shore								
Sandy shore		2	1	1	1			**5**
Unidentified shell								
Land snail			1					**1**
Fish bone		1	1					**2**
Bird bone								
Flora								
Charcoal		1						**1**
Seeds								
TOTAL	**6**	**18**	**13**	9	6			**52**

Table 5.9 Hearth site R06-24. Portable material culture excavated from surface of terrace [Feature OBJ ID 2604], adjacent to Hearth 2

	E53.3 N43.3 Stone hearth 2	**E53 – N42 obsidian & shell**	**E52.3 – 43.3 W of hearth 2**	**E56 - N33 Pit/ Sunken area**	
Obsidian	34	4	3	1	**42**
Rhyolitic tuff	3				**3**
Siliceous tuff	2				**2**
Breccia					
Red ochre	1				**1**
Chert					
(water rolled)					
Unidentified rock	1				**1**
Artefact	2				**2**
Rocky shore		1	1		**2**
Sandy shore	5	1			**6**
Unidentified shell					
Land snail	1				**1**
Fish bone	2				**2**
Bird bone					
Charcoal	1		1		**2**
Seeds					
TOTAL	**52**	**6**	**5**	**1**	**64**

Comment:

The investigation of this sunken feature was limited to the recording of surface features and the excavation of a small test pit. Despite this, the feature is confidently interpreted as an in-filled storage pit. This is based in part on its rectangular shape and 3.5 x 2 m dimensions which are consistent with pits found throughout the Northland New Zealand area, and that the type of soil and the undifferentiated/bio-turbated profile found here is very similar to that found in the adjacent in-filled pit located 14 m to the west (discussed below).

Part 3. Pit terrace

Located roughly 25 m south of hearth 1 are two smaller terraces (Figure 5.27). The lower of these two was trenched to determine the nature of its stratigraphy and construction, and to determine the original ridge slope lines. This trench was dug between 2.4 m and 9.5 m along a secondary baseline that starts at 0 m at grid point E35.1 N20.3?,and runs on a 192 degree bearing for 16.2 m when it joins the central area baseline at grid point E40 N37 (Figure 5.28 and 5.29). The excavation took the form of spading a 40 cm wide trench along the baseline and down a maximum of 1 m to the natural subsoil.

Description

The stratigraphy revealed by this trench has a 10 cm black humic topsoil over, a 15-25 cm thick medium brown soil. Below this is a confused mix of re-deposited material that includes yellow brown mottled fill, yellow-tan clay and rubbly red-yellow clay. Only the interface between the natural hard clay-ash subsoil and the fill layers above is a defined line. A3 m long dark brown rectangular feature was first noticed in layer 3 that extended down to the natural yellow subsoil. Cut into this clay subsoil is a small drain in line with the rectangular feature above (Plate 5.20).

Comment

The floor drain implies that this is a food storage pit that was in-filled at some later time to form a terrace. The base of this feature is clearly defined, however the upper 80 cm is very confused with mixing and inter mixing of layers of fill. Even the topsoil (1) and brown fill soil (2) interface is disturbed. Extrapolation from the visible section of drain gives a 3.5 x 2.5 m measurement for a pit base that runs at 45 degrees to the line of the trench (Figure 5.29).

The portable material culture identified from this excavation was primarily lithic in origin. From the surface, bothin and around the trench, two pieces of obsidian, some unidentified sea shell, and one historic wind up watch were identified. Excavated material was recorded in two primary spits. Spit 1 extended from 0-10 cm and covers the brown/black topsoil (number 1 on the plan).

This contained obsidian (16), local rhyolite (4) and siliceous tuff (1) and one small fire cracked water rolled pebble. Spit 2 extended from 10-40 cm and incorporated the medium brown pit fill (number 2 on the plan) as well as the top of yellow brown mottled pit fill (number 3 on the plan). This contained obsidian (11), rhyolitic tuff (1) and siliceous tuff (1). No portable material culture was retrieved from the remaining disturbed fill layers in the pit (Table 5.10).

Plate 5.20 Hearth site R06-24 – Trench 1. Looking north along trench. The excavated floor drain of the reburied food storage pit is partially visible where it cuts into the natural yellow ash subsoil. [Feature OBJ ID 10] [Hansen 2005 IMG_4945]

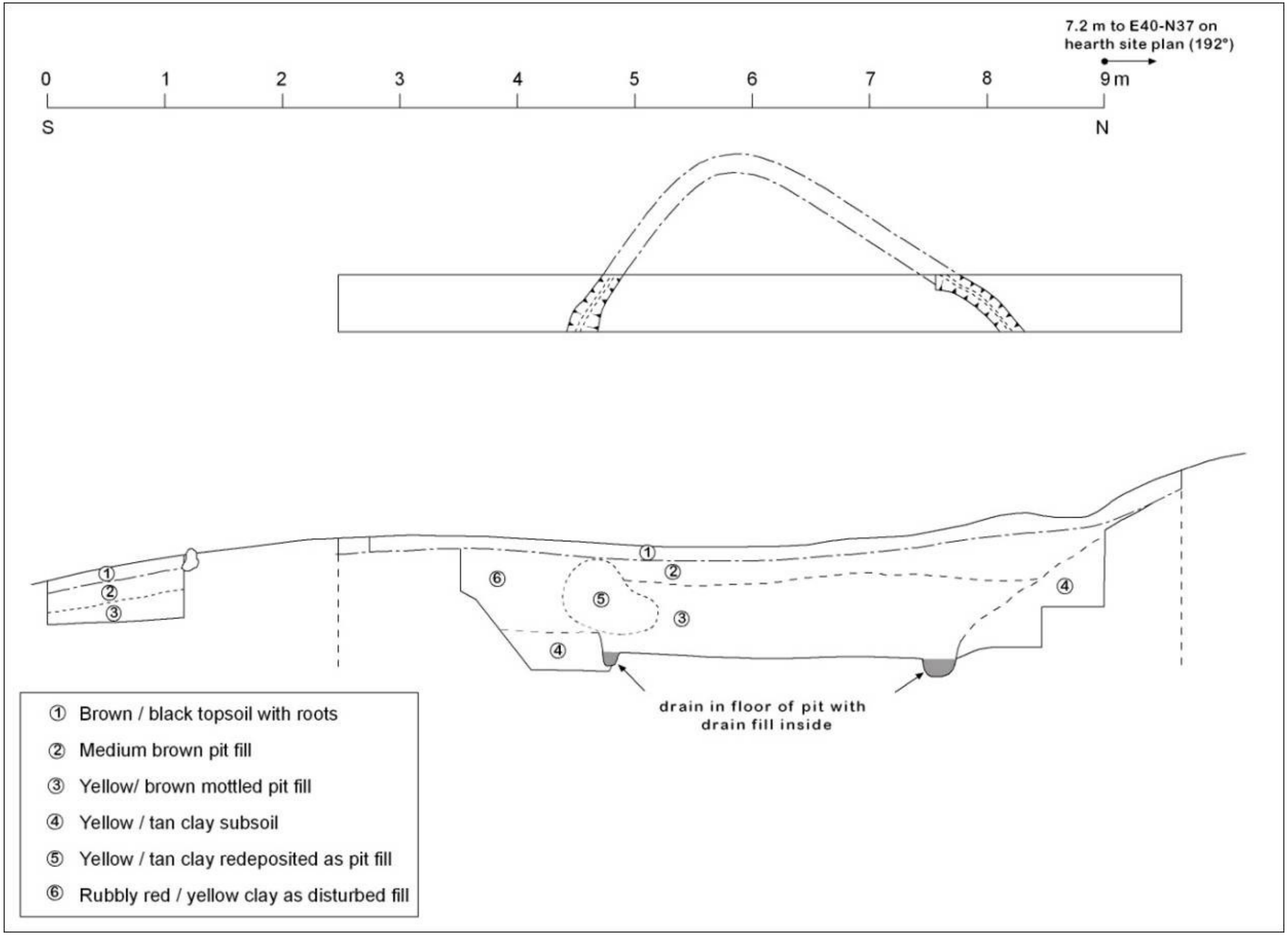


Figure 5.29 Hearth site R06-24 – Trench 1. Section and plan through Pit 1 showing bio-turbation and intact pit drain features. [Feature OBJ ID 10]

Table 5.10 Hearth site R06-24 – Trench 1. Portable material culture excavated from the trench and adjacent terracesurface.[Feature OBJ ID 10]

	Surface (On terrace)	**0-10 cm (In trench)**	**10-40 cm (In trench)**		**TOTAL**
Lithics					
Obsidian	2	16	11		**29**
Rhyolitic tuff		4	1		**5**
Siliceous tuff		1	1		**2**
Breccia					
Red ochre					
Chert					
(water rolled)		1			**1**
Unidentified rock					
Artefact	1				**1**
Fauna					
Rocky shore					
Sandy shore					
Unidentified shell	1				**1**
Land snail					
Fish bone					
Bird bone					
Charcoal					
Seeds					
TOTAL		**22**	13		**39**

* Refers to material that has been burnt ** Refers to scatters ***Refers to hammer stone artefacts

Part 4. Lithic work floor R06-25

Approximately 20 m south east of the large terrace there is a 30 x 30 m concentration of mostly lithic material concentrated on the gently sloping top of the ridge that descends south-west towards Camp Bay. Like a similar lithic concentration located at the Carver site 400 m to the east it was decided to do a non-random sampling of the material present on the ground surface. To this end two crossing transects running west-east and north-south respectively were laid out using meter tapes. 1 x 1 m squares were strung up along these two transects. These squares were consecutive along the line but were placed at irregular intervals on one side or the other of the line depending on where the largest number of artefacts could be seen. Once strung up each square was numbered, cleared of loose leaf litter and all visible portable material culture was uplifted and bagged (Figure 5.30).

Description

The artefacts uplifted were primarily obsidian with some water rolled hammer stones made from sinter, basalt and local siliceous volcanic rock. A detailed analysis of these artefacts is made in chapter 5 Part III.

Comment

Site R06-25 is clearly a lithic work floor. A comparison between this work floor located at the southern side of the Hearth site and the other large work floor found a kilometer to the east at the southern end of the Carver site shows some remarkable similarities (Table 5.11; Figures 5.30 &5.31). Looking just at material bagged within these work floors, both are clearly specialist sites with virtually none of the mixed lithic and faunal material found 20-30 m to the north in the more central parts of the Hearth Site and the Carver Site where generalized habitation occurs.

Table 5.11 Portable material culture collected from the two largest lithic work floors – R06-25 [Feature OBJID 157] and R06-27[Feature OBJID 130]

Lithic work floors	**R06-25**	**R06-27**	**TOTAL**
Obsidian w cortex	57 (45%)	190 (76%)	**247**
Obsidian w/out cortex	69 (55%)	60 (24%)	**129**
Obsidian cores	7	19	**26**
Rhyolitic tuff	18	2	**20**
Siliceous tuff	5	4	**9**
Breccia	1		**1**
Basalt	3*		**3**
Red ochre		2	**2**
Chert			
Water rolled - Rhyolite	5(2***)	4(2***)	**9**
Water rolled - Sinter	3***	5***	**8**
Water rolled - Basalt	4(1***)	1***	**5**
Unidentified rock			
Artefact (adzes)		2	**2**
Rocky shore	2		**2**
Sandy shore	1	1	**1**
Unidentified shell			
Land snail			
Fish bone			
Bird bone			
Charcoal			
Seeds			
TOTAL	**175**	**290**	**465**

* Refers to material that has been burnt ** Refers to scatters *** Refers to hammer stone artefacts

The primary difference between these two lithic work floors is the percentage of cortex present.

The lithic work floor found at site R06-25 shows 45% of its obsidian flake assemblage retains some cortex while the obsidian work floor at sites R06-27 has 76% of the obsidian flake assemblage retaining cortex (Table 5.11). This may relate to functional differences between the two specialist sites. One interpretation of this has the lithic work floor at the southern end of the Carver site as a primary flaking area where the obsidian cobbles are initially reduced. In contrast, the lithic work floor at the southern end of the Hearth site could be where secondary flake tool manufacture or repair of existing flake tools occurs.

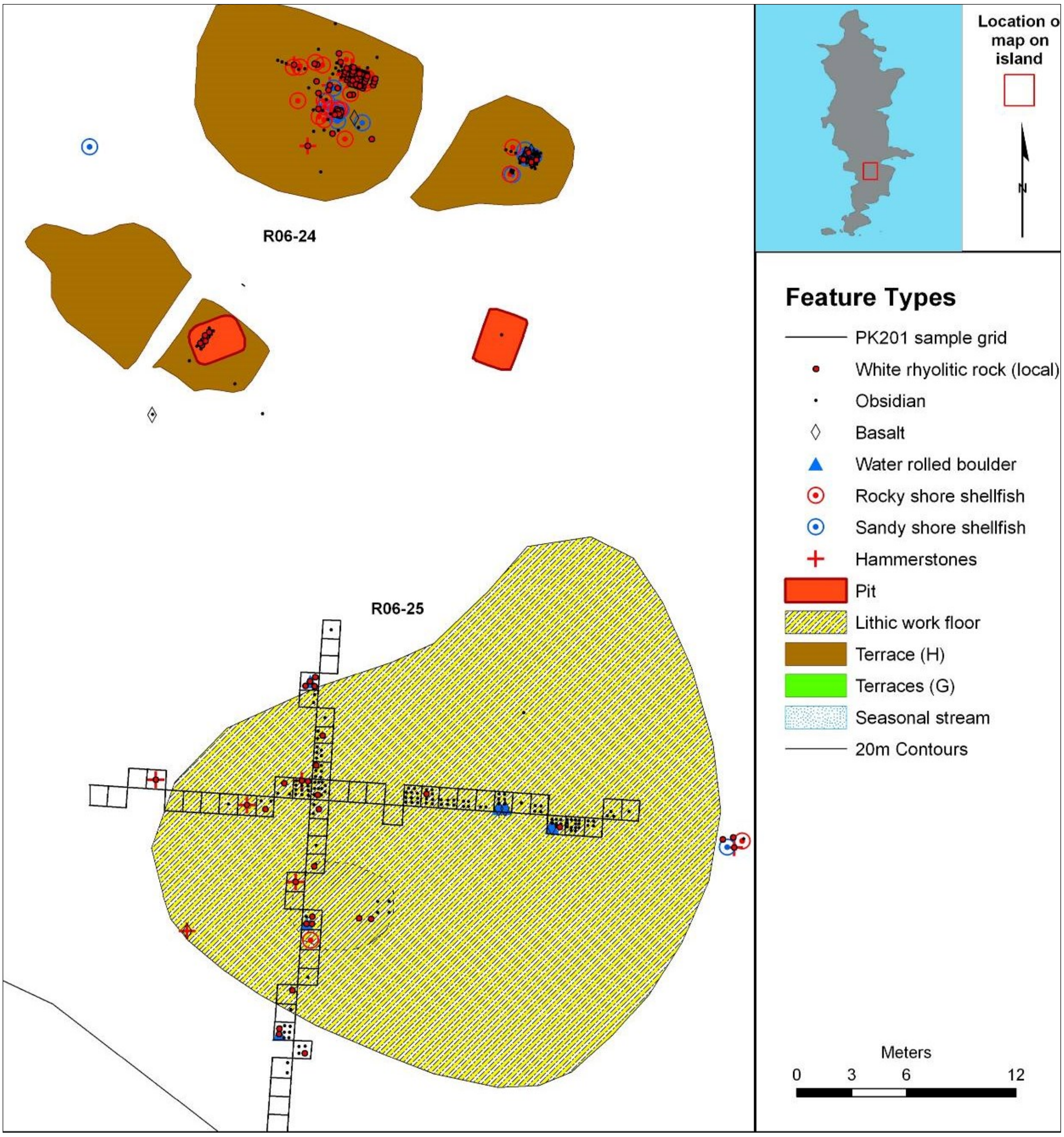


Figure 5.30 Portable material culture recorded from the lithic work floor (R06-25) and the Hearth site (R06- 24).

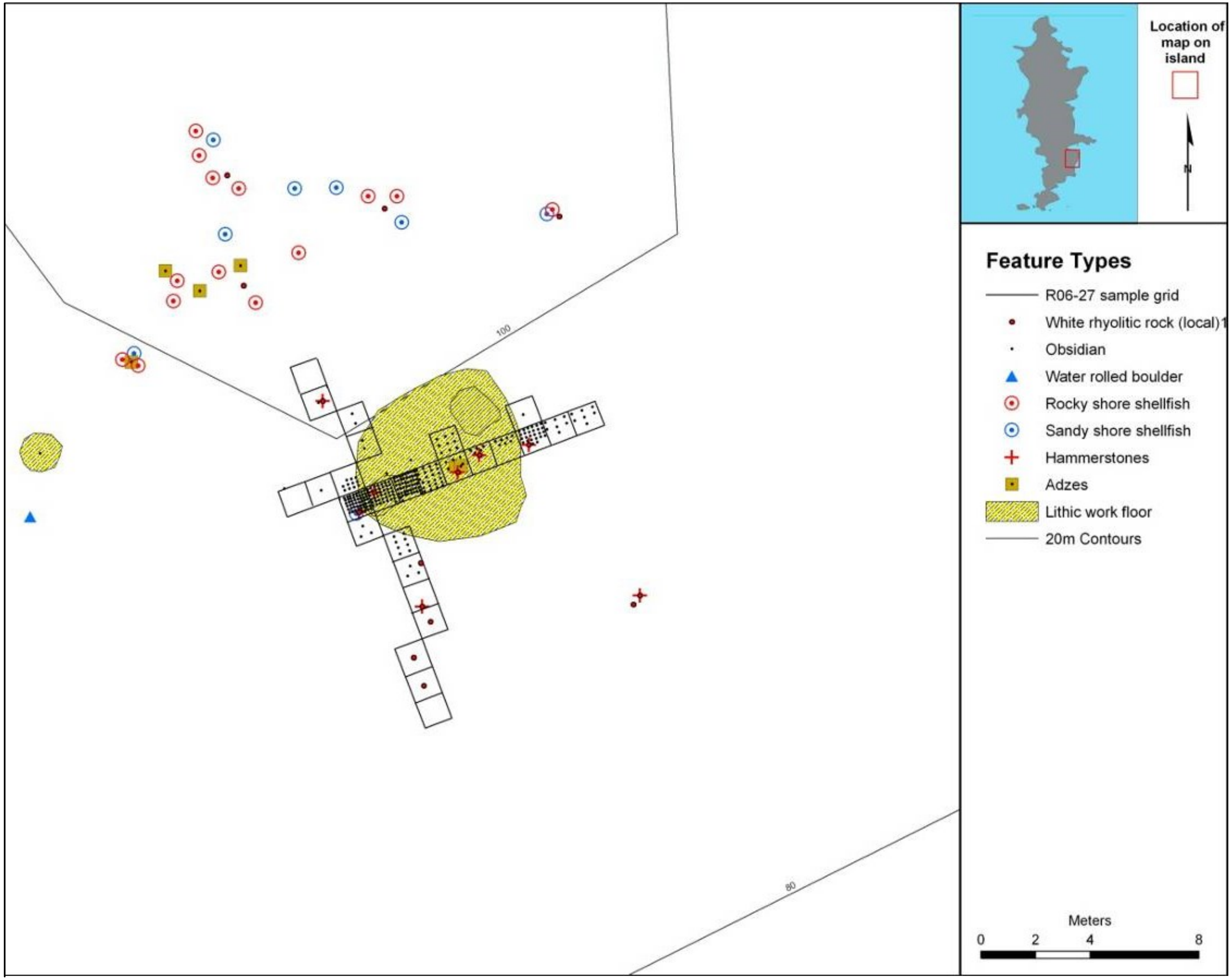


Figure 5.31 Lithic work floor at R06-27 showing the portable material culture in and around the 50 cm surface sampling grid.

Conclusion

Site R06-24 is defined by both the portable material culture and the structural built elements. It suggests that the large central terrace and the smaller eastern terrace were associated with the cooking and/or the consumption of food. The presence of lithics in the form of a few hammer stones, occasional chert flakes and numerous obsidian flakes immediately north of the stone edged hearth 1 suggests that generalised tool making and repair also occurred here. Since the chert, obsidian and the sandy shore shell fish species do not originate in or around the Poor Knights, their importation to Tawhiti Rahi suggests some form of interaction with communities on the Northland mainland to the west and/or to Great Barrier Island to the east.

The lines of post holes suggest that linear wooden features such as fence lines or possibly house structures were present. The finding of obsidian pieces from the surface down to 30 cm deep is deceptive. Rather than reflecting a particularly long period of human occupation their presence in an undifferentiated soil with no extant cultural horizons suggests that this vertical 30 cm spread is caused bybio-turbation of surface deposited material by burrowing sea birds. The presence of fish bone and shell fish faunal material along with fire crackedor burnt local stone between and inside the two similar and adjacent stone edged hearths suggests this was a single event settlement by one group of people.

Site R06-25 is located 20 m to the south-east down a gently sloping ridge from site R06-24. It is a lithic work floor whose large assemblage is dominated by obsidian (134) along with twelve water rolled pebbles of basalt and sinter of which at least five are hammer stones. Clearly the Hammer stones have been used to reduce obsidian cores to make flake tools. It is not clear exactly how this specialized site R06-25 relates to the adjacent living area of R06-24 but they appear to be contemporary.

The sunken areas to the east and the buried pit site to the south are both interpreted as food storage areas presumably for use by the inhabitants who gardened the adjacent southern lowland valley. The southern pit appeared from the surface evidence to be only a terrace, however excavation clearly showed that it originally contained a pit feature that had been in-filled at some later date. This sequence of construction events implies that occupation was ongoing for at least a few years. Whether this occupation was continuous or intermittent is hard to determine due to the action of burrowing sea birds that has destroyed any floors or buried surfaces that would have been present somewhere in the site's stratigraphy.

In summary, sites R06-24 and 25 include leveled living areas, tool making in lithic work floors, food preparation and food storage and are considered here to be one site. These are all elements associated with habitation and occupation by Māori with social links most likely to the Northland mainland and/or Great Barrier Island. The in-filling of both pits indicate a degree of time depth to the actual occupation of the site, and the dominance of material culture on or near the surface hints that the intensity of this occupation increased in the latter period of occupation. Although suitable material for dating was recovered from a spatial context, the extensive evidence of bioturbation meant that their vertical stratigraphic context was suspect and therefore no samples were selected for radiometric dating.

The obsidian which dominates these two sites is analysed in Part III of this chapter, but even during the excavation the ubiquitous 'grey' colouring suggests one or more local Northland sources that are known to become important later in prehistory. Therefore the type of obsidian found and the lack of European material present implies a rough chronology whereby this site was constructed and in use late in the prehistoric sequence, roughly between1600 and 1800AD.

5.2.2 Ceremonial

5.2.2.1 Puketuaho Hill (R06-12). Limited area excavation

Located on the northern plateau on the central ridge geographic area 6, Puketuaho Maunga (Hill) is a high point that rises abruptly up from this central ridge that runs north-south along the centre of the northern plateau. This large kidney shaped hill was clearly a major focus for Māori settlement as it is densely covered in terraces and stone features. This maunga was identified specifically from oral history (Chapter 3) as a likely 'Wananga' (place of learning) and from general traditional history as being of possible ceremonial significance since such high points are often used as burial sites. From the archaeological survey (Chapter 5 Part I) the three high points on the island - of which Puketuaho is one - are recorded as ceremonially significant. This is due to the Citadel (R06-19) having a cache 'urupa' (burial) on its summit and the other two, the Beacon R06-6 and Puketuaho R06-12, having the rare sub-vertical retaining wall feature encircling the hill top that appears to separate a lower habitation zone from a small enclosure of tapu features at the top of the hill. While the top of the Beacon site (R06-6) was leveled as part of the automated lighthouse construction in the late 1960s, the top of Puketuaho contains intact features in the form of small terraces with raised stone rims.

In an attempt to confirm if the top of Puketuaho actually was of ceremonial significance, two small scale investigations were carried out. The first of these focused on determining the function of the sub vertical retaining wall and associated terrace (Excavation 1)(Figure 5.32 & 5.33), while the second investigated the function of one of the small raised rim terraces enclosed at the top of the hill (Excavation 2) (Figure 5.32 & 5.34).

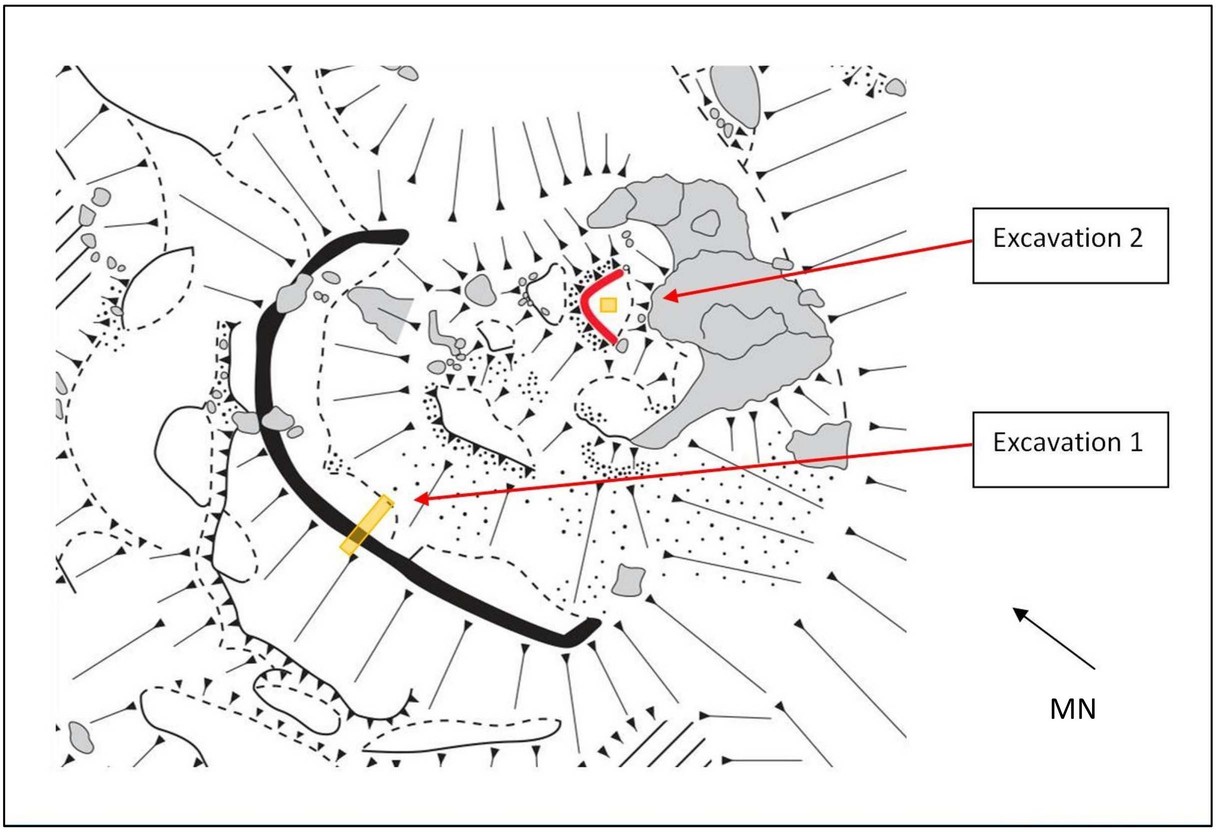


Figure 5.32 Puketuaho Hill R06-12. Location of excavations 1 and 2 on the summit

<u>Excavation 1. Terrace with sub-vertical retaining wall</u> The top 20 m of elevation of the Puketuaho is bounded by steep to vertical natural cliffs to the east and south and a man made earth terrace that curves around from the west to the north. This terrace is 25 m long and 2 to 3 m wide. Large numbers of Buller Shearwater have dug their burrows into the terrace surface [Feature OBJ ID 1128]. At the front this terrace is retained by a rare feature – a sub-vertical stone wall [Feature OBJ ID 1130], while the back of the terrace is formed by a large outcrop of rhyolitic rock that slopes upwards to the east to ultimately form the top of the hill. The excavation focused on understanding the function of this terrace (Figure 5.33, Plate 5.21).

A base line was strung up across the terrace. Initially a 50 x 50 cm test pit was dug on this terrace hard up against the inside of the stone wall [Test Pit 1]. A second test pit was dug immediately outside the wall [Test Pit 2]. These test pits were extended to form a trench that cuts through the terrace and a short distance downhill. All parts of the trench were excavated down to the bedrock and the eastern section drawn.

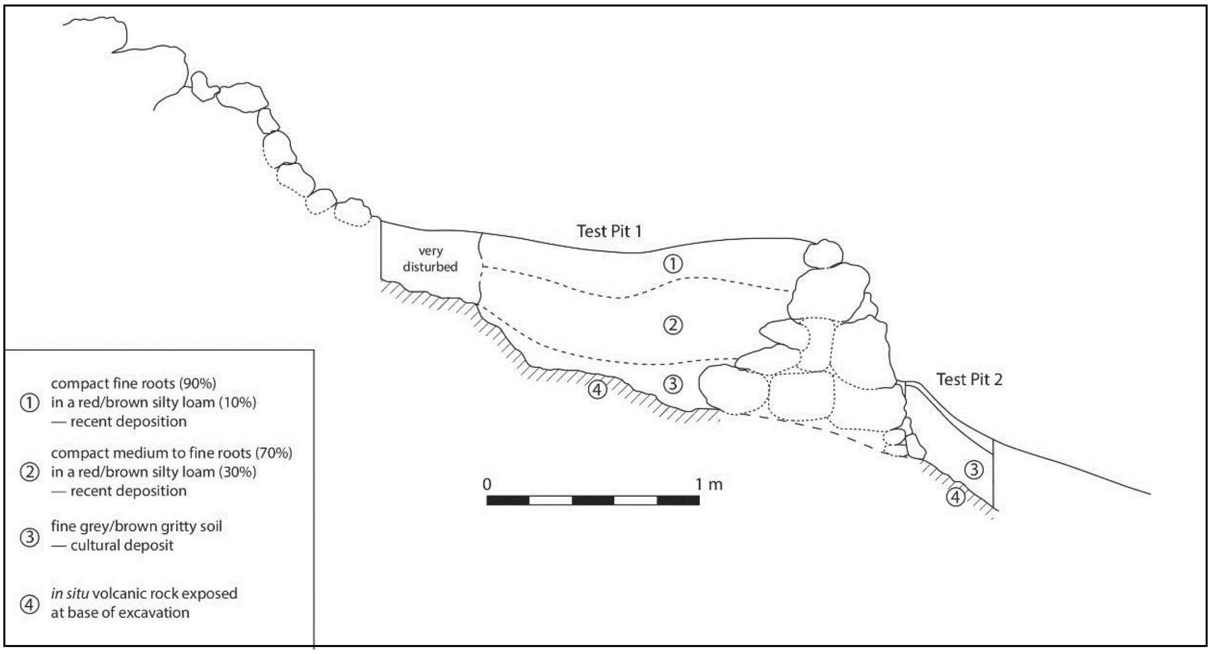


Figure 5.33 Puketuaho Hill R06-12. Excavation 1. Section drawing of the east baulk of the trench that forms excavation 1. Here the sub-vertical retaining wall originally thought to retain the terrace is shown to be a free standing stone wall. Excavation revealed that the terrace itself is not cultural but rather is the result of a natural build up of leaf litter and roots that occurred after human abandonment of the island.[Feature OBJ ID 1117]

Plate 5.21: Puketuaho Hill R06-12. Excavation 1. Completed excavation of the just below the summit of Puketuaho Hill. The free standing stone wall is visible to the front. [Feature OBJ ID 1117][Robinson 2005 022_21A]

Description

The section drawing shows two thick bands of matted roots (Layers 1 and 2) over a thin grey/brown soil (layer 3) located directly on the naturally occurring white ashy rhyolitic bedrock (Table 5.12).

Layer 1: 70% fine Metrosideros root mass and 30% brown to red/brown silty soil.
Layer 2: 90% fine root mass plus larger roots of Metrosideros &10% red/brown soil.
Layer 3: Grey/brown sandy or ashy soil with some roots.
Layer 4: Compacted rock-like white ash subsoil and naturally occurring rhyolitic rock.

Under a thin layer of humic dried leaf litter, test pit 2 that forms the trench extension on the downhill side of the wall contained a dark fine grained grey/brown ashy soil. This is similar enough to be considered the same as that found in layer 3 uphill of the wall. Again the base of excavation consisted of compacted rock-like white ash subsoil and naturally occurring rock.

Table 5.12 Puketuaho Hill R06-12. Excavation 1. Description of material excavated in 10 cm spits from the terrace associated with the sub-vertical retaining wall [Feature OBJID 1128].

Layer	Spit	Depth	Description
1	1	0-10 cm	Brown humic soil held within a matrix of roots. Very hollow due to bird burrows
2	2	10-20 cm	Dark grey ashy soil within a matrix of roots. Hollow gaps created by bird burrowing.
	3	20-30 cm	Dark grey ashy patches give way to further red brown humic soil. Some darker areas appear but all found within a matrix of a mass of fine roots.
	3	30-40 cm	Humic red brown soil continues. Now very large tree roots mix with the fine root mass.
3	5	40-50 cm	Soil here is a pale grey humic material. In are found shiny quartz like inclusions suggestive of sand or a very thin ash layer admixed with clay. Large roots are still encountered here.
	6	50-60 cm	More of the grey ash/sand layer but now admixed with red/brown humic soil. Large roots had to be removed along with a lot of root mass – soils very soft/friable
	7	60-70 cm	White/grey ash clay soil is very fine with humic inclusions from above. Probably eroded material from basal clay found at the 70 cm base.
4	8	70-? cm	Around the exposed volcanic rock base the ash layer is now concreted and white in colour.

Comment

The root mass that makes up layers 1 and 2 has very little soil content and no artefacts. This suggests that this stone structure was not, as originally thought, a sub-vertical retaining wall but rather a free standing wall. The implications of this is that the level terrace behind the wall is for the most part a natural feature that developed through leaf litter build up and the expansion of pohutukawa tree species on the island following human abandonment. The only confirmed cultural horizon with artefacts is layer 3 which is found on both sides of the wall and may well predate the walls construction. To test the premise that this wall demarks a tapu (sacred) area at the top of the hill, a second excavation was undertaken on Puketuaho – this time focused on a small terrace with raised stone rim located near the summit of the hill well above this wall.

Excavation 2. Terrace with raised stone rim

Near the summit of Puketuaho there is a cluster of five small stone faced earth terraces on the western slopes, measuring one to three meters deep and two to six meters long. A sixth terrace measuring one m deep and four meters long has no earth component but rather is cut directly into the rhyolitic bedrock just below the summit. The top most earth terrace is unusual, being nearly oval in shape and bounded by a raised stone rim above its retaining wall [Feature OBJ ID 1117]. The excavation focused on understanding the function of this earth terrace (Plate 5.22).

First, a base line was strung up along the long access of the terrace and a small 50 x 50 cm test pit was dug on this line near the back of the terrace and excavated in 10 cm spits down to the natural rhyolitic bedrock. Once completed, a section was drawn of the southern test pit wall (Figure 5.34).

Description

The section drawing shows a thick band of matted roots (Layers 1) over a grey brown to black ashy soil (Layer 2) located directly on the naturally occurring white ashy rhyolitic bedrock (Layer 3) (Table 5.13).

Layer 1: 50% fine root mass and 50% brown to red/brown silty soil.

Layer 2: 30% slightly larger roots of Metrosideros and 70% of grey/brown sandy or ashy soil.

Layer 3: Compacted rock-like white ash subsoil and naturally occurring rhyolitic rock.

A human cranium was partly exposed in the southern and western walls of the test pit (Plate 5.23). No other lithic, floral or faunal material was uncovered. Following agreed protocols with Tangata Whenua (traditional owners), all excavation stopped with the confirmed discovery of human bone and Ngatiwai Trust Board was informed. Following consultation the test pit was in-filled and the excavation of this terrace halted.

Plate 5.22: Puketuaho Hill R06-12. Excavation 2. The terrace looking north with the raised rim of stone wall [Feature OBJID 1117] [Welch April 2005]

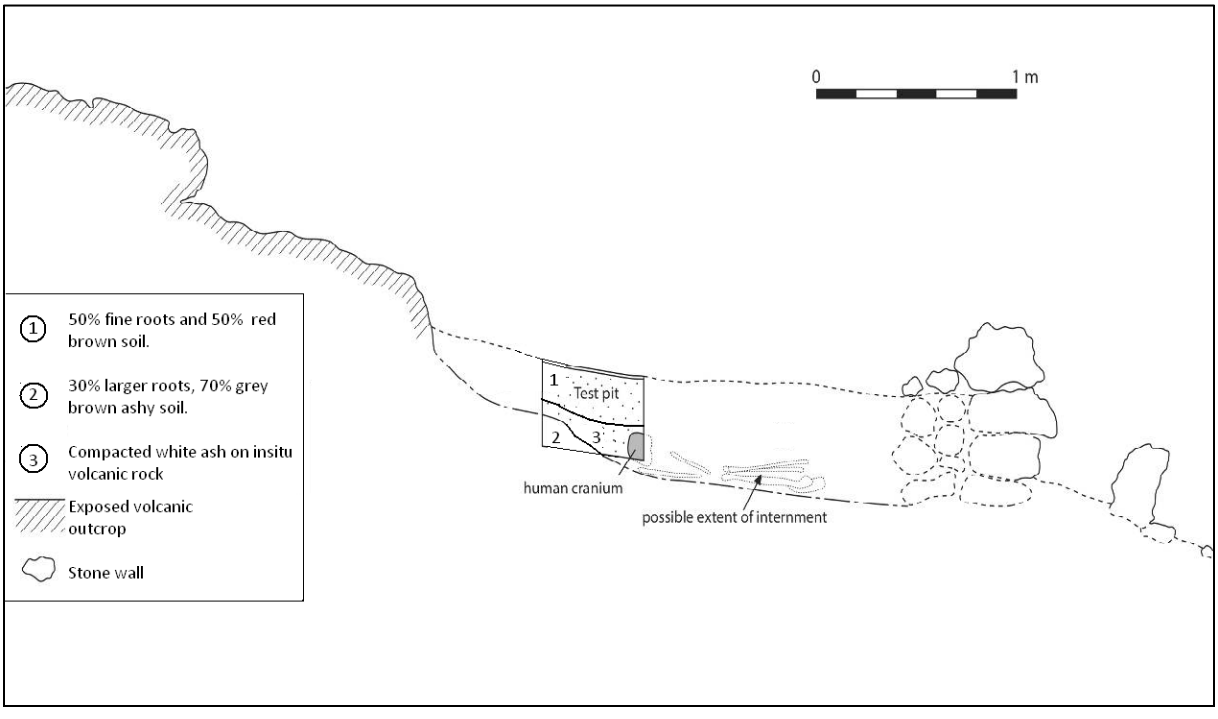


Figure 5.34 Puketuaho Hill R06-12. Excavation 2. A section drawing of the test pit dug through the raised rim terrace near the summit of Puketuaho Hill. The human cranium located in the test pit is drawn and the predicted location of the reminder of the burial is also shown. The dot and dash line is the probed rock base of the terrace.

Table 5.13 Puketuaho Hill R06-12. Excavation 2. Description of material excavated from the raised rim terrace [Feature OBJ ID 1117].

Layer	Spit	Depth	Description
1	1	0-10 cm	Light brown humic loamy soil held within a matrix of roots. Bioturbated presumably by bird burrows in the past.
	2	10-20 cm	Mid brown to dark brown soil within a matrix of roots. Bioturbated by bird burrowing.
2	3	20-30 cm	Grey brown to black 'ashy' humic soil. Some mixing with red brown from the spit above. Within a zone of larger roots. Contains some charcoal.
	4	30-40 cm	Grey brown to black 'ashy' humic soil. Some mixing with red brown loam from above as well as stony inclusions of volcanic rock from the bedrock below. Still within a zone of larger roots. Contains some charcoal. Contains the human burial.
3	5	40-? cm	Around the exposed volcanic rock base the ash layer is now concreted and white in colour.

Plate 5.23 Puketuaho Hill R06-12. Excavation 2. The completed excavation of Test Pit 1 in the raised rim terrace on Puketuaho Hill[Feature OBJ ID 1117]. The cranium located is visible in the western corner of the excavation. [Hansen 2005 IMG_4957]. Pre-

inhumation cranial puncture damage is visible in the enlarged inset photo. [Hansen 2005 IMG_4955]

Comment

The root mass that makes up layer 1 has very little soil content and no artefacts, suggesting that like excavation 1, it had formed after the island was abandoned by its human inhabitants. Layer 2 however is similar to layer 3 found in Excavation 1 both in color and texture (but not artefacts), and is also considered to be a confirmed cultural horizon associated with a human burial.

Following the agreed protocol with the Ngatiwai Trust Board the bone was not removed from its location in the test pit wall, however examination showed cranium to have fused sutures confirming that the individual was an adult. The most interesting feature of the cranium was a triangular hole in the left side of the visible skull (Plate 5.23 INSET). Dirt and discoloration on the exposed broken sections confirm that this injury happened prior to our excavation and may have been the cause of death. It's location within a soil horizon that contains ash and some charcoal suggests that this is a deliberate burial. Measurements show that the cranium faces east (275-290 degrees), back towards the mainland. Assuming that the cranium is part of an in-situ body present in the unexcavated part of the terrace, the individual is likely to be laid on their right side. The section drawing shows only 1.2 m of space between the cranium and the raised rim wall, whichis too short a distance to allow an extended burial for the adult individual, butsufficient to allow a flexed/crouch burial.

Conclusion

Two excavations were carried out near the summit of Puketuaho Hill. The small test pit excavation on the raised rim terrace just below the summit uncovered a human burial whose flexed location is consistent with Māori cultural practices prior to European arrival. The trench excavation on the lower encircling terrace shows that the terrace is largely a construct of post human abandonment leaf litter build up and tree root growth. As such the stone facing is not, as first thought, a sub vertical retaining wall, but rather a free standing stone wall. This feature type is rare on Tawhiti Rahi and is interpreted here as a boundary marker separating the urupa (burial) on the hill top above from the noa [profane] activities on the garden and house platforms below. Some support for this idea is that first, noa items such as shell fish are only found below the wall, while obsidian that can have tapu connections is found above. Second, this wall is built near the top of a high point and such places on the mainland commonly contain Māori burials. If correct, then similar obscured stone structures found at the Citadel (R06-19) to the south and at the light Beacons site (R06-03) to the north may also be hidden free standing stone walls. This is further supported by the fact that the citadel also contains a burial.

5.2.3 Specialist

5.2.3.1 Cave site (R06-17)

Rhyolitic dome caves occur in a number of places in the Poor Knights Islands group, however the only one currently known above sea level is on Tawhiti Rahi Island. Located in the Southern Stream Valley geographic area 11, this natural cave encompasses archaeological rock shelter site R06-19 and is located on the western side of the southern lowlands on the north side of the Citadel headland. It is situated 30 m up a gully where the headland meets the main body of the island, and is screened from easy view by Pohutukawa trees. Land access is possible by walking west from the Citadel site (R06-18) down the steep cliff edge through an extensive seabird colony to the cave. However the team chose a sea access route whereby a boat motored from Camp Bay north around the Citadel headland and then landed on the large boulder beach that has formed at the foot of the scree gully (Plate 5.24). Using a support rope, personnel climbed up to the cave entrance carrying the excavation gear. This naturally formed cave contains extensive evidence of human use, and so in archaeological terms is defined as a rock shelter. Both terms are used in the following discussion. The cave entrance is 8 m wide and 2-3 m high. Outside of the drip line located at the entrance of the rock shelter there is a collapsed stone retaining wall, presumably constructed and backfilled to stabilize the cave floor. Inside, a broadly level surface extends back 15 m. Heading from the entrance inwards, the first 11 m of the cave is 6 to 8 m wide and retains a 2 m high roof (Plate 5.25). This 11 x 8 m zone is the main occupation area of the rock shelter.

Plate 5.24 Rock shelter site R06-17[Feature OBJ ID 2911]. The entrance to the cave is hidden by trees above a bolder beach. [Robinson 2010IMG_263]

Plate 5.25 Rock shelter site R06-17[Feature OBJ ID 2911]. Looking from the baseline out west tothe cave entrance. [Walter 2005IMG_3779]

It is characterised by a floor of dry, fine silty soil that grades from red to grey in colour and is partially obscured by an extensive deposit of cultural charcoal, lithics and faunal material. Occasionally patches of white volcanic ash are visible on the cave floor. Structural features visible on the surface include hearths defined by concentrations of burnt rock and charcoal,andadjacent linear arrangements of water rolled rocks.

Continuing 11 to 15 m inside, the cave progressively narrows and the roof lowers until only a gap of 30 cm remains between the roof and the floor. Crawling through this low gap reveals a smaller second inner cave inhabited by cave weta (*Gymnoplectron giganteum*). The roof of this inner cave is 2-3 m high, and the floor of the inner cave is damp and red/brown in colour. The inner cave floor rises towards the inner eastern end, due to in-washing of soil. There were no cultural features visible on this floor, and portable material culture found here is limited to a few sea shells. The damp, in-washed soil appears to be relatively recent and is probably associated in some way with a partial collapse of the inner cave roof. It is possible that there is a buried occupation horizon under this material, but this was not investigated during excavation activities.

The archaeological investigation carried out in this rock shelter occurred in the larger outer cave and was focused on determining the function of the site and collection offaunal or floral material from an intact stratigraphy for radiometric dating. The methodology chosen involved both excavation and surface material collection. Since the surface cultural material and features are very well preserved, the methodology chosen required us to minimise the excavation footprint to two 50x 50 cm test pits sited in undisturbed material, and to a 2 m trench near the entrance in an area that had been undermined and collapsed by seabird burrows. Excavated material from these three excavations was either sieved on plastic sheets using a 3.2 mm sieve and then bagged, or not sieved but collected and bagged as whole samples. At the end of the investigation, all excavated holes were lined with plastic bags and backfilled with spoil. Bagged material was taken to University of Otago for analysis, and selected samples were sent away for radiometric dating. Upon completion, the cave was returned as near as possible to its original state.

The rock shelter investigation is summarised in three parts: Part I involves the recording of structural elements, and the non-random collection of surface deposits of portable material culture. Part II involves excavation of the trench in the disturbed outer area of the rock shelter. Part III records the excavation of two 50 cm pits in the main undisturbed body of the rock shelter. Following this, a discussion is made of the cave's stratigraphy, general archaeology and chronology, and how this might inform our understanding of the nature and timing of Māori settlement on Tawhiti Rahi Island.

Part I: Surface collection

First a numbered baseline was established running west to east down the centre of the cave and the cave was then drawn in plan (Figure 5.35). This plan shows the cave floor to contain both scatters and concentrations of lithics, floral and faunal material in and around a minimum of five open fire places defined primarily by concentrations of charcoal. The portable material culture visible on the floor of the rock shelter includes worked and not worked wood, faunal material in the form of fishbone, shellfish and mammal bone, and lithic material that includes obsidian and water rolled rocks. The cave floor was carefully walked over and all visible stone flake tools and shell fish were bagged and uplifted. Ten examples of wood lying on the floor (A-J) were not collected but rather were drawn on the plan, photographed and small samples cut from them for later microscope species identification (see Chapter 5 Party III). A number of these wood pieces have adze cut marks showing them to have been worked (Plate 5.26). Following this, a series of 39 adjacent 50 x 50 cm squares were strung up both along the baseline and extending north and south from it. These traversed at least two of the fire places as well the floor in general. All the surface portable material culture encountered in these squares was carefully swept up and bagged as whole samples. The contents of these bags were subsequently identified at the Otago University Archaeology laboratory using nested 6.4 mm and 3.2 mm sieves.

Discussion

A total of 23 kg of faunal, floral and lithic material was recovered from the non-random sampling of the floor of this rock shelter, and from excavation test pits 1 and 2, and the trench (Figure 5.36). Fire cracked rock and large charcoal pieces dominated the assemblage especially where the sampling squares extended across hearth C, but were also found in smaller amounts throughout the cave west of the alignment of eight water rolled boulders. The breakdown of material identified in the laboratory is summarised below. All portable material culture including cultural flora and fauna along with a range of lithic material was entered into the GIS and from this a site specific overview of the material culture is given below (Table 5.14). A detailed analysis of cultural material recorded from this cave and the rest of the island is made in Chapter 5 Part III.

Culturally deposited lithic material identified from the cave floor includes onesiliceous tuff core [Point OBJ 950], 26 flakes of obsidian found scattered in the northern half of the cave floor and 20 large water rolled basalt stones. These measured from 15 to 25 cm in length and have no surface damage that could be associated with their use as anvil stones for knapping. Instead they appear to form boundaries either for hearths or (as discussed in Part I) as conceptual boundaries. Other lithics thought to be non-cultural include a floor wide scatter of small, burnt, locally sourced rhyolitic rock, along with occasional fragments of 'flow stone' – a tarry material formed in caves from the percolation of water through the substrata.

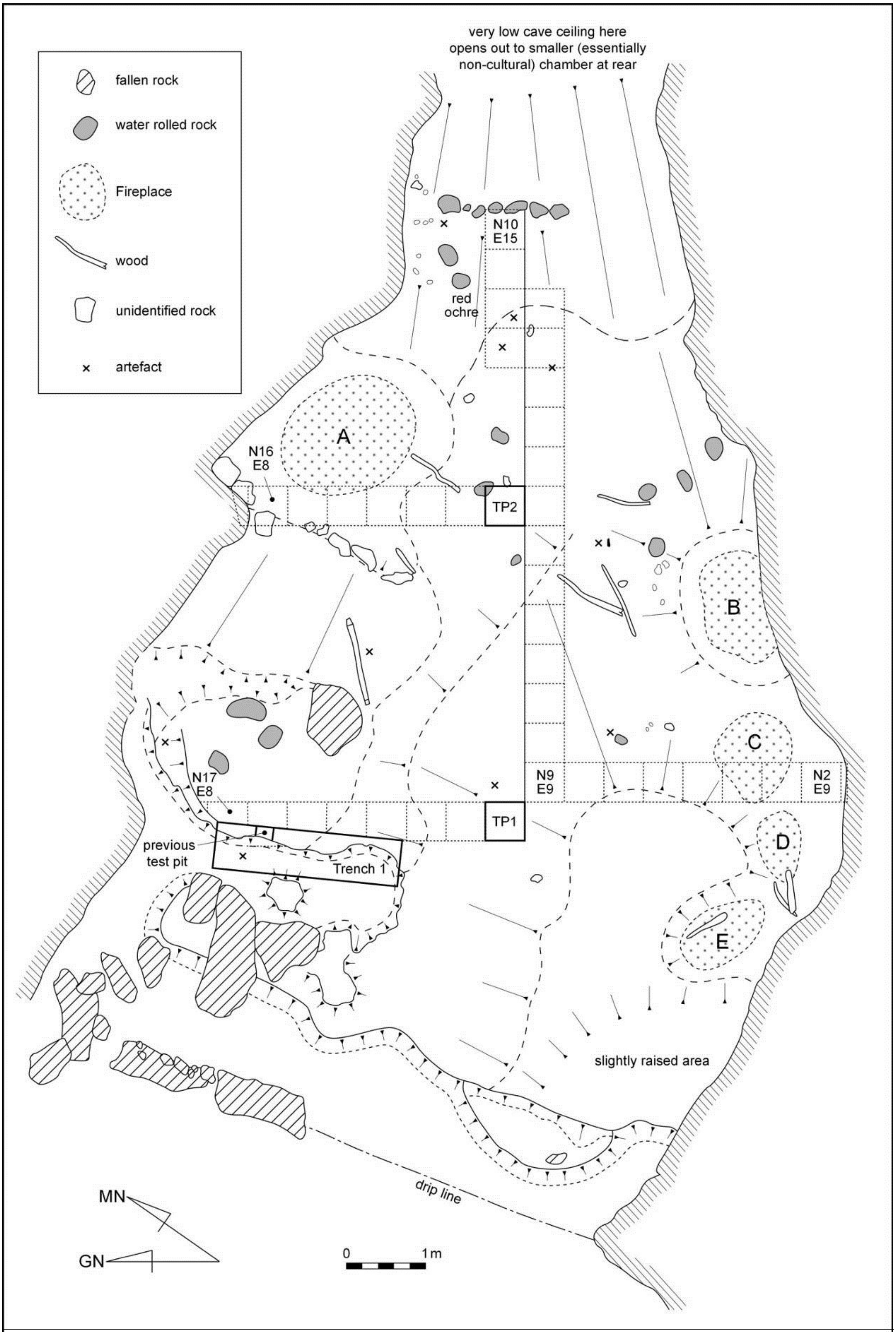


Figure 5.35 Plan view of the main cave in rock shelter site R06-17. Two test pits and one trench were excavated while the ladder grid shows the surface sampling strategy followed.

Plate 5.26 Rock shelter site R06-17, adzed wood sample 'A' [Point OBJ 1012]
[Walter 2005IMG_3771]

Floral material recovered included the extensive deposits of charcoal that covered the floor of the cave west of the water rolled boulder stone alignment, and the large wood pieces (discussed in Ch 5 Part III). These whole wood pieces included akeake, houhere, makomako, rewarewa and rimu native species. Some of these show evidence of adze cut marks [Point OBJ 1012]. Apart from the rimu all of the wood could be sourced from the island itself. Smaller quantities of seeds, leaves, twigs, fibre and some wood flakes were occasionally found on the rock shelter floor and in test pit excavation 1 (Plate 5.27). Of these, the wood flakes with adze marks are clearly man made, while the fibre, despite being very fragmentary, may constitute flax or flax matting being used on the floor of the cave. Most of the seeds or seed cases have yet to be identified, however a single mature gourd seed has been identified from the surface of the cave [Point OBJ 1726], and ten others have been excavated from Test Pit 1 [Point OBJ 1585]. Since such seeds only form in mature gourds that are no longer edible, their presence suggests that seed instigated gourd cultivation was occurring somewhere on the island (Clarke pers. comm 2008).

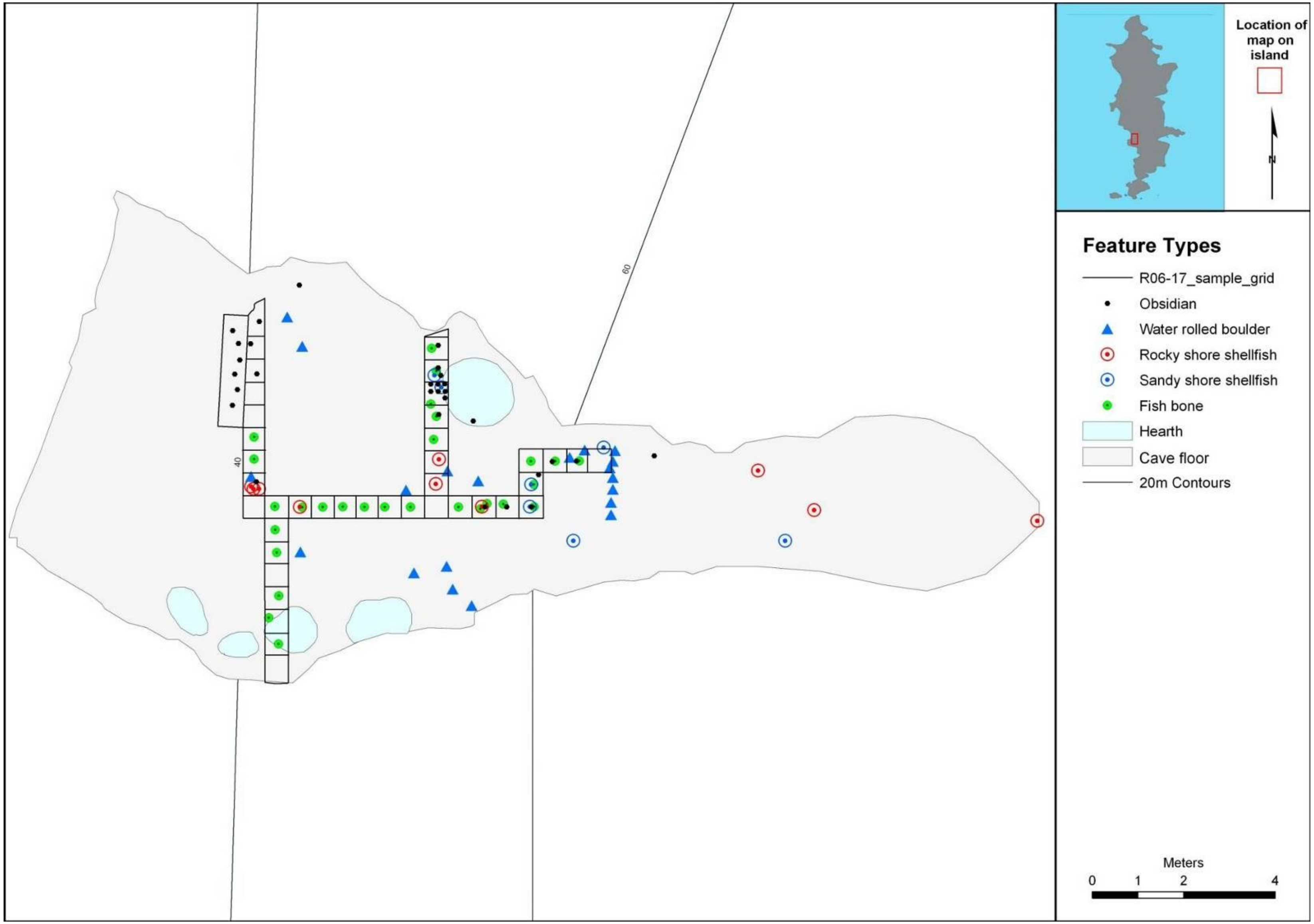


Figure 5.36 Plan view of the inner and outer cave in rock shelter site R06-17[Feature OBJID 2911]. Shows the five hearth features overlaid with faunal and lithic portable material culture recorded in the GIS.

Table 5.14 Rock shelter R06-17, portable material culture excavated from the cave surface, trench & test pits.[Feature OBJID 2911]

	Surface sweeps	TP 1	TP 2	Trench 1
Obsidian	26	1		3
Rhyolitic tuff	1			
Siliceous tuff	3			
Breccias	2			
Red ochre	3	1		
Chert				
(Basalt water rolled)	20	1		
'Flow' stone	1			
Unidentified rock				
Artefact	Adzed wood chip (6)	Adzed wood chip (8)	Adzed point of a tool (1)	
Rocky shore	6	3		
Sandy shore	7			
Unidentified shell	4			
Land snail	7	6	1	
Fish bone	28**	15.68gm*	yes	various
Bird bone	6**			
Dog bone	3			
Pig bone	2			
Unidentified bone	1			
Unburned wood	15			
Charcoal	53**	20.81*	yes	various
Unidentified Seeds	7			
Gourd seeds	1	10		11
Fibre	2	13.66*	yes	various

*Refers to bag weights rather than individual items ** Refers to number of bags

Plate 5.27 Rock shelter R06-17, fibre [Point OBJ 1548] identified in NW corner of TP 1, top of spit 4 (14-19 cm). This material also contained adzed wood chips & gourd seeds [Point OBJ ID 1585] that has a calendar date range of 320-480 BP.
[Walter 2005 IMG_3909]

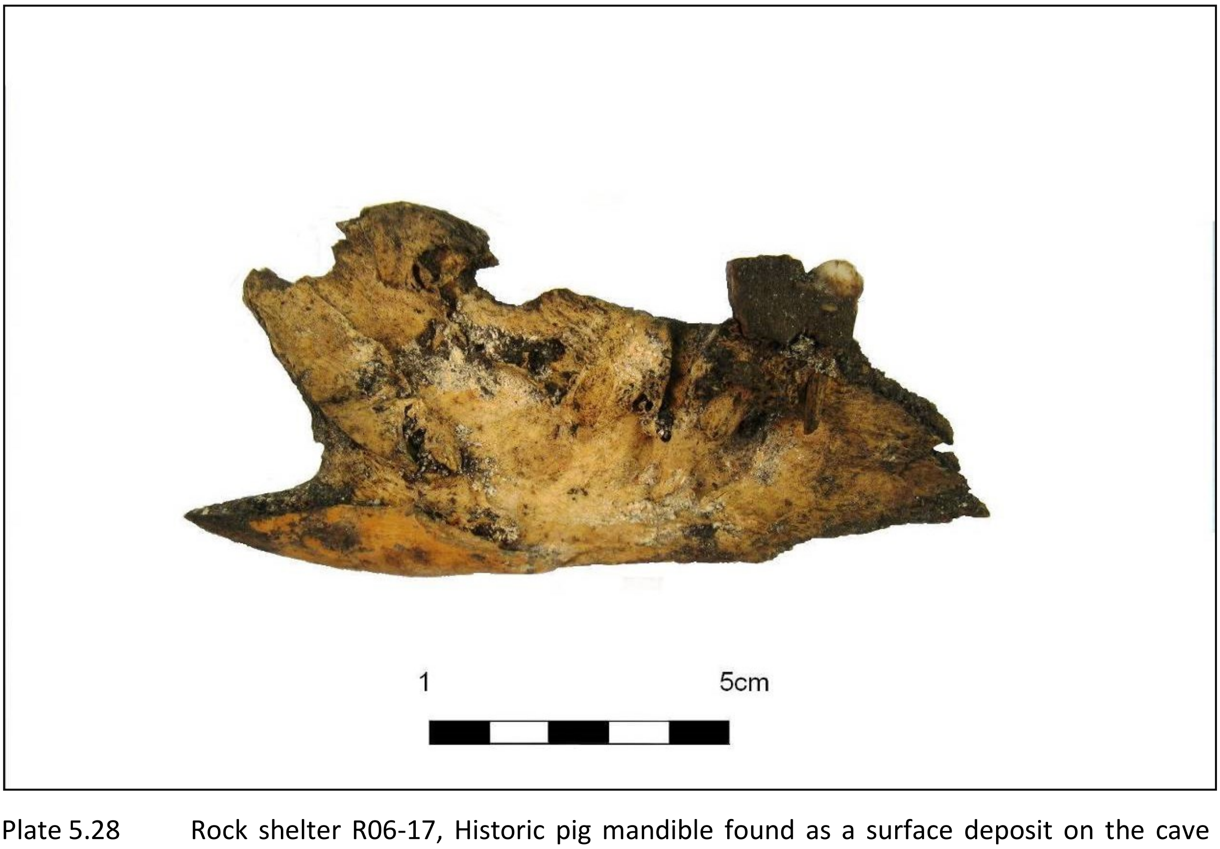


Plate 5.28 Rock shelter R06-17, Historic pig mandible found as a surface deposit on the cave floor[Point OBJ ID 1011]. [Robinson 2008 DSCF_3307]

Mammalian faunal material recovered included fragments of dog vertebrae and long bone [Point OBJ 1767 & 1789] and two fragments of pig mandible [Point OBJ 1011 & 1784] (Plate 5.28)**.**However in terms of total number, fishbone dominated, being found in nearly all of the 50 x 50 cm surface sampling squares west of the alignment of water rolled basalt boulders [Point OBJ 990-995]. The smaller number of shell fish found came from both the swept squares and from the earlier floor survey. These shellfish included sandy shore species such as six pipi (*Paphies australis*)and one cockle (*Chione stutchburyi*),as well as rocky shore species such as two white rock (whelk) shells (*Dicathais orbuta*),two rock oysters (*Saccostrea cucullata*) and a single examples of mussel (*Perna canaliculus)*, black nerita (*Nerita atramentosa*) and limpit (*Cellana denticulata*). All shell fish were found in the south-east half of the cave. Unlike the charcoal and fishbone, shellfish were also found in the smaller inner cave to the east. Occasionally, whole or fragments of land snail shells (*Placostylus hoongii*) were recovered throughout the cave.

Comment

The floor of this rock shelter was extensively utilised during the final phase of island occupation. Activities taking place in the rock shelter include cooking and stone tool use. The lack of any hammer stones or obsidian cores suggests that this was not a lithic workshop, and that tool manufacture occurred elsewhere. Except for the presence of two fragments of pig mandible, all portable material culture uplifted is consistent with a prehistoric timeframe. This suggests that the cultural material on the cave surface was deposited early in the historic period, just after 1800AD when pigs were being domesticated by Māori, but before European sourced artefacts came into common use. Determining when occupation started will be addressed by excavation of the two test pits and one trench.

<u>Part 2 Excavation</u>

Three small excavation units were dug in the cave. Two of these were 50 x 50 cm test pits located within the grid squares laid out for the surface collection. The third was a trench oriented along the remnant unmodified edge of a bird burrow disturbed area that cut across the grid squares.

Test Pit 1

This test pit is located in grid square E8 N10 (Figure 5.35 & 5.36)**.** A section drawing of the east baulk shows a complex stratigraphy of many lenses and layers (Figure 5.37). The lenses and layers in the top 9 cm of the section run parallel to the sloping surface of the cave that slopes upwards from north to south (0-9 cm) while the lenses and layers below this (9-22 cm) run parallel to the horizontal dark orange brown natural subsoil below. A total of seven spits were excavated over a total depth of 36 cm. All cultural material located was found in the top four spits (Spits 1-4) that occur between the surface and 19 cm deep. Cultural material recovered from these four spits included scatters of fishbone, shell fish, charcoal, adzed wood, basalt and obsidian flakes, cultivated seeds and fragments of fibre that might be the decayed remains of fabric. Spits 5, 6 and 7 are considered to be non-cultural.

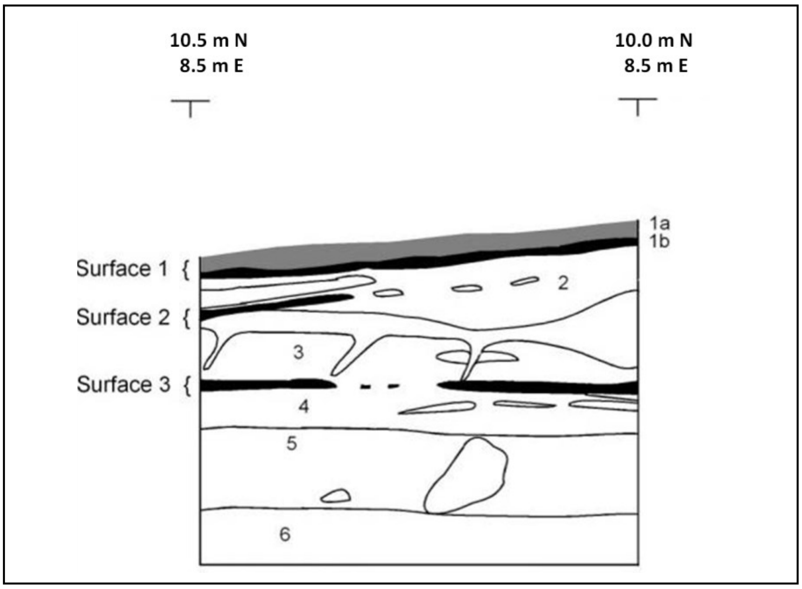


Figure 5.37 Rock shelter R06-17:East baulk of Test Pit 1 showing cultural Surfaces1, 2 and 3, that are associated with the adjacentspits 1a, 1b, 2 and 3.

Within the general zone of cultural activity between the current floor of the cave and 19 cm deep there are three distinct cultural surfaces. Surface 1 (0-2 cm) is the current cave floor and is the most recent deposit that is continuous across the section and slopes up towards the south. Surface 2 (9-11 cm) is below this and forms a discrete lense that also slopes up to the north, parallel to the current cave floor. It sits on top of the sterile spit 3 that is horizontal and does not follow the slope of the current cave floor. Surface 3 (14-16 cm) is the deepest and earliest occupation layer. It forms a lense at the top of sterile spit 4 that is horizontal and doesn't follow the slope of the current cave floor.

The complexity of the stratigraphy and the variability in the depth of each of these living surfaces meant that spits were abandoned as excavation units and instead each surface was followed. Spits were retained only as a guide to excavated material (Table 5.15).

Table 5.15 Portable material culture excavated from TP 1 in the cave site R06-17.[Feature OBJID 2911]

Spit depth	**Surface**	**Spit 1**	**Spit 2**	**Spit 3**	**Spit 4**	**Spit 5-7**	**TOTAL**
Depth (cm)	Surface	2-5 cm	5-9 cm	9-14 cm	14-19cm	Natural	
Lithics							
Obsidian w/out cortex					1		**1**
Obsidian cores							
Rhyolitic tuff							
Siliceous tuff							
Breccia							
Basalt							
Red ochre				1			**1**
Chert							
Water-rolled-Rhyolite							
Water rolled - Sinter							
Water rolled - Basalt				1***			**1**
Unidentified rock							
Artefact (adzes)							
Unidentified rock					1		**1**
Artefact							
Fauna							
Rocky shore			1	2			**3**
Sandy shore							
Unidentified shell							
Land snail		1**	1**	3	1		**6**
Fish bone		1		4			**5**
Bird bone							
Flora							
Charcoal		1**	1**	3**	1**		**6**
Seeds					1***		**1**
Wood		2***	2***	4***	2***		**10**
Fibre		1***	1***		2***		**4**
TOTAL		**6**	**6**	**18**	**9**	**0**	**39**
* Refers to material that has been burnt ** Refers to scatters ***Refers to culturally modified material							

Surface 1: This surface is formed by the top of spit 1b (2-5 cm) and includes all the loose material found above it from spit 1a (0-2 cm). The loose material consisted of dry fine grey brown silt. No lithics were present in this material but a number of clumps of concreted ash were collected along with numerous charcoal fragments. The top of spit 1b contains a black charcoal rich 'greasy' soil but no charcoal fragments. The interface between spits 1a and 1balso contains fibre material that might be decayed flax or flax fabric [Point OBJ 1696] along with small wood fragments, some of which appear to have been adzed and in one case burnt [Point OBJ 1545 (burnt) & 1546]. No faunal material was present.

Surface 2: This surface is a lense that is found at the top of spit 3 (9-14 cm). This intermittent lens of fine grey dark brown silt varies from 2-3 cm in thickness and extends across most of the section. It contains charcoal, fishbone, red ochre (1) [Point OBJ 1555], rocky shore shellfish (2) [Point OBJ 1577-8] and small wood fragments some of which appear to have been adzed [Point OBJ 1573-1576]. Again like surface 1 above, some fragments of fibre were noted [Point OBJ 1548]. Placostylus land snail shells that are also found in this lens but appear to be non-cultural.

Surface 3: This surface is found at the top of spit 4 (14-19 cm) and extends in a near continuous line across the section. It is a 2-5 cm thick lens of fine dark brown to black silt containing charcoal, a small wood fragment that has been adzed [Point OBJ 1571] (Plate 5.26) and fragments of fibre material (2) that might be decayed flax [Point OBJ 1569-1570] (Plate 5.27). Most importantly, it contained ten seeds identified as hue/bottle gourd (*Lagenaria siceraria*) [Point OBJ 1585] (Plate 5.45).

Test Pit 2

This test pit is located in grid square E12 N10 (Figure 5.35& 5.36). The section drawing of the east baulk shows a large water rolled basalt boulder on the cave surface [Point OBJ 999] and a complex stratigraphy of many lenses and layers below this (Figure 5.38).

The lenses and layers in the top 8 cm of the section run parallel to the sloping surface of the cave which slopes upwards from north to south, while the lenses and layers below this (8-38 cm) run parallel to the horizontal dark orange brown natural sub soil found below 44 cm. A total of seven spits were excavated over a total depth of 28 cm. A further 25 cm was spaded out but was not sampled as it was clearly non-cultural. Unlike test pit 1, the material bagged and collected from test pit 2 was not comprehensively analysed. Instead, the material was looked at to identify presence or absence of cultural material with only the adzed wooden artifact point and the fiber examinedin any detail. The reasoning for this was to retain unprocessed material for future study

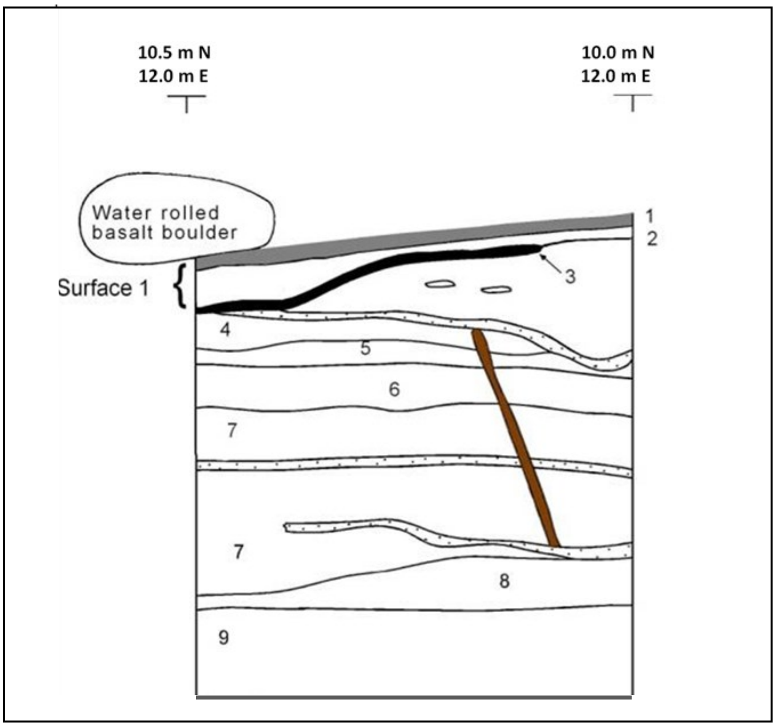


Figure 5.38 Rock shelter R06-17: East baulk of Test Pit 2 showing occupation Surface 1 associated with the adjacent spits 1-3. The brown object is a piece of wood of unclear provenance.

The three upper most spits 1, 2 and 3 contain cultural material in the form of compact surfaces, scatters of fishbone, rare shell, flakes of charcoal, adzed wood and fragments of fibre that might be the decayed remains of fabric or rope. Together these are identified as Surface 1 and include all the loose material recovered in total sample bags 105 and 106. Spit 1 consists of dry fine grey brown silt containing large fishbone and some Placostylus (land snail) shell. No lithics were present in this material, but numerous small fragments and some larger charcoal pieces were collected. Spit 2 (2-5 cm) is a compact grey ashy layer containing, charcoal, small fishbone, a mussel shell [Point OBJ 1247] and some naturally occurring flow stone (bags 236 and 237). Spit 3 (5-8 cm) is a red/brown silty soil with numerous flow stone fragments. It is only where spit 3 interfaces with spit 2 in the north east corner of the excavation square that cultural material are found in the form of a thin compact lense within which were recovered fibre fragments [Point OBJ 1797] and a small finely adzed point to a wooden artifact occurs [Point OBJ 1798].

Very dark brown/red fine silty material was identified in spit 5, 7 and in the baulk at 27-32 cm. Initially thought to be cultural, laboratory analysis shows that samples of this material do not contain charcoal or any portable material culture. Therefore, all layers below the interface of spit 3 and 4 are considered to be non-cultural. The vertical wood object (brown object in Figure

5.38) in these non-cultural spits has a possible cut end and has been identified as Metrosideros umbellata (Point OBJID 1470, Appendix 6i). This appears to have been used as a stake driven into the cave floor probably originating from spit 3 within surface 1.

Trench 1

This test trench is located within the grid squares at E8.0-8.3 N11.4-14 m (Figure 5.35). Unlike Test pits 1 and 2, Trench 1 does not follow the 50 cm grid pattern, but rather is orientated along the back face of a collapsed bird burrow area near to the front of the cave but still a few meters inside the cave entrance drip line. In an area of 2.5 m, a total of seven spits were excavated to a maximum depth of 1.3 m (Figure 5.39). Probing the base of the trench determined that there was at least another meter of in-situ soil remaining, however the lack of space to deposit large quantities of excavated material without modifying and/or burying other cultural deposits in the intact parts of the inner cave, along with the loose or collapsing nature of the lower deposits, made further excavation downwards unfeasible.

The section drawing of the trench's east baulk shows a complex stratigraphy of multiple lenses and layers. Those lenses and layers in the top 15 cm of the section run parallel to the sloping surface of the cave that slopes upwards from north to south, while all lenses and layers below this (15 cm down to 1.3 m) run parallel to spit 7a, a concreted layer of horizontally running flow stone found at 60-70 cm deep.

Cultural material was only located in the top four spits (Spits 1-4) between the surface and 15 cm deep, and consisted of fishbone, charcoal, and three obsidian flakes [Point OBJ 967-969]. The non-cultural horizontal layers below the cultural material consist of clumps of yellow/white ashy material in a red/brown varying soil matrix (spits 5 & 6) and a range of sterile damp silty/clay soils ranging in colour from brown through to red in spit 7. Of particular interest are horizontal layers of hard coal like deposits found in a boundary layer in 7a and occasionally in 7b. These may be a form of 'flow stone' formed when moisture passing through the cave walls and floor picks up salts and deposits them horizontally in the floor layers. Despite containing some dark bands of material, spits 5, 6, 6a, 7, 7a and 7b (15 cm to 1.3 m) contain no charcoal or cultural material and are therefore considered to be non-cultural.

Within the upper zone of cultural activity between the surface and 15 cm deep there is only one distinct living surface titled Surface 1.This is made up of the four upper most spits 1, 2, 3 and 4that all contain cultural material in the form of compact surfaces, lenses, scatters of fishbone, rare sea shell, flakes of charcoal, adzed wood and fragments of fiber. The fiber may be the decayed remains of fabric or rope. Together these are identified as Surface 1.

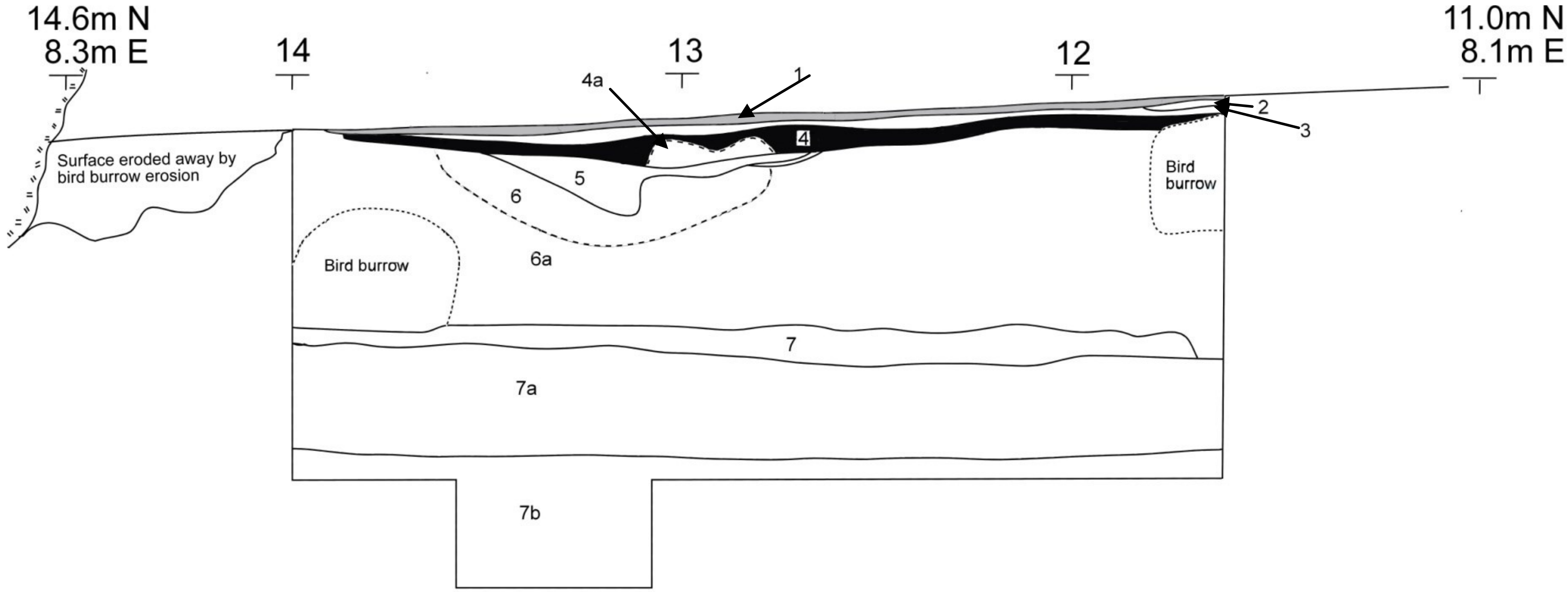


Figure 5.39 Rock shelter R06-17: East baulk of Trench 1. Excavation showing occupation surface 1within the adjacentspits 1-4.

Surface 1 includes the compact black material containing charcoal and ash visible at the top of spit 4 (4-15 cm). Above this there a fine loose grey silty soil that is spit 3 (2-4 cm) that appears to be decayed organic material that becomes better preserved and more fibrous where it passes under the small white clumpy ash lense of spit 2 at the southern end of the section. Above spits 2 and 3 is the loose grey/brown coloured soil of spit 1 (0-2 cm) that extends across the trench section. Charcoal and fishbone are visible nearby on the surface of the cave, but nothing was recovered within the relatively small area troweled when cleaning down the face exposed by bird burrowing.

Comment:
Spatially, the section drawings of the Test Pits 1 and 2, and Trench 1 (Figures 5.37, 5.38 & 5.39) show occupation surfaces overlaid with numbered arbitrary spits. The layer coloured grey represents the consistent presence of loose charcoal, fishbone and occasional shell fish and wood that is found throughout the present floor of the cave and in all three excavations. The black coloured layer(s) represent confirmed sub-surface living floors that are compact, charcoal rich, containing rare lithics as well as variety of fauna, flora and in particular fiber that are also found in all three excavations. The white layer between the grey and black layers in figure 5.38 and 5.39 contains fragments of decayed fiber that might once have been woven flax. Stratigraphically the investigation of these three excavation units shows evidence of three phases of occupation in rock shelter site R06-17.

<u>Occupation Phase 1.</u> Described as 'Surface 3', this is the oldest phase of occupation encountered in cave site R06-17. It is only visible in Test Pit 1 and occurs at 14 cm deep. It consists of ash, charcoal and organic material that includes fiber and gourd seeds that forms a thin and nearly continuous layer across the section. It sits on a compact sterile white ash and runs parallel to the horizontal natural layers below, and not to the current sloping floor of the cave above. As such it is separated from a more recent occupation reflected in surface 2 above by varying depths of grey, white and pink sterile ash bands.

<u>Occupation Phase2.</u> Described as 'Surface 2', this is the second phase of occupation and is only visible in Test Pit 1. It consists of an intermittent surface of charcoal, fishbone, shell fish and ochre at 9 cm deep. It is separated from occupation phase 1 below by grey, white and pink sterile ash bands and from occupation phase 3 above by a single band of sterile white ash. This surface slopes upwards to the south and is parallel to the current surface (Occupation Phase 3) of

the cave. Since it is not discernibly different in content from the surface above, it may be contemporary with Surface 1, the most recent period of occupation.

Occupation Phase 3. Described as 'Surface 1', this is the largest, most complex and most recent phase of occupation. It consists of a series of three adjacent layers that run perpendicular to the sloping cave floor, and is found at the top of the stratigraphic sequence in all three excavation units, namely Test Pits 1 & 2 and the Trench. These adjacent layers consist of (i) a compact charcoal and ash surface 4-8 cm deep that contains faunal and floral material. Laid on this floor is (ii) a partial covering of a thin grey organic layer with occasional fibre that is visible only in Trench 1 and Test pit 2. It is possible that this grey material may be decayed flax matting laid on the floor of the cave. Above this is (iii) the top most layer contains large quantities of charcoal, fish bone, shell fish and cultural lithic material. This culturally dense zone is found at the top of all three excavation units and is also visible over most of the cave floor. To place these phases of occupation into calendar dates a series of radiometric determinations were made on excavated seeds, fibre and twigs from Test Pit 1, and an age/depth model produced.

Carbon Dating

To provide a direct measure of how long people may have occupied rock shelter/cave site R06-17, a grant from the Australian Institute of Nuclear Science and Engineering (AINSE) enabled three standard AMS radiocarbon dates to be obtained from Australian Nuclear Science and Technology Organisation (ANSTO) in Australia. Samples of cultural material for radiocarbon dating were archaeologically excavated from a stratigraphic sequence dug in test pit 1, and simple AMS radiocarbon determinations were calculated by the ANSTO Laboratory (Fink et al., 2004). Dates were then calibrated using the southern hemisphere calibration curve and then combined with additional information from the archeological site using Bayesian models (Appendices 8:ii, 8:iii, 8:iv).

Three samples were chosen from two of the three cultural surfaces identified in Test Pit 1. Specifically twiggy wood (Bag 211D) and gourd seeds (Bag 213) were taken from Occupation Phase 1, and woody fibre thought to be flax (Bag 183) taken from Occupation Phase 2. No material was taken from the Occupation Phase 3 [Surface 1] as it is assumed to be modern due to the presence of historic pig bone. The use of AMS was essential, as it allowed the small sample size of the woody fibre, twiggy wood and especially the gourd seeds to be dated. Radiocarbon ages for these samples have been successfully produced and calibrated age ranges have been made (Figure 5.40).

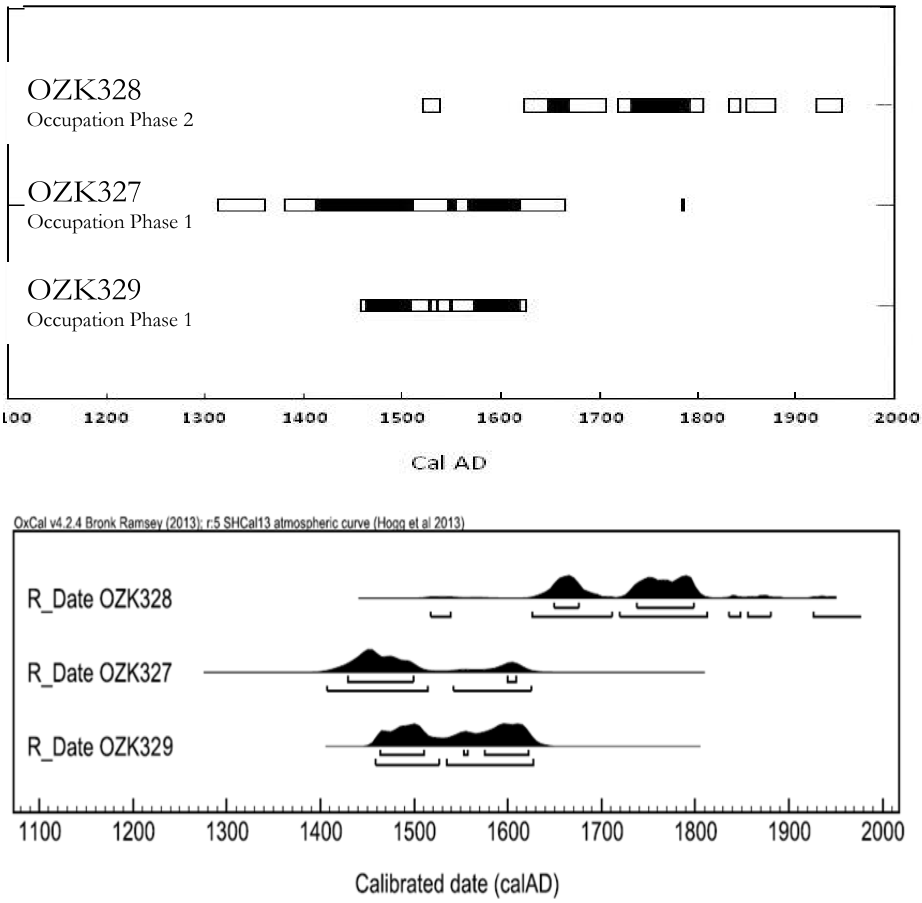


Figure 5.40 Rock shelter R06-17, Test Pit 1. The calibrated date range using Ox Cal v4.0.5 (Bronk Ramsey 2007)[Appendix 8:iii].

Model Based Estimates

Factors relevant to the Bayesian age/depth model (Appendic 8:iv) include (i) the minimal inbuilt age problems from gourd seeds that are directly associated with Polynesian horticultural and (ii) the presence of historic pig bone among the cultural material found on the current surface of the cave (occupation phase 3) that implies a proto-historic use somewhere around 1800AD.

The Bayesian approach allowed radiometric data to be incorporated with stratigraphic data from the cave, along with cultural and historic knowledge to increase the accuracy of the calendar date range of occupation in the cave. The practical effect of this is to constrain the calibrated age range. A summary of this data are discussed below, and shown in Table 5.16 and Figure 5.40.

Table 5.16 Rock shelter R06-17, Test Pit 1. Radiocarbon determination results (Funk et al., 2004) [Appendix 8:i], the calibrated date range using Ox Cal v4.0.5 (Bronk Ramsey 2007)[Appendix 8:iii], and the Bayesian modelled date range (Dillingham 2007) [Appendix 8iv].

Carbon Dates	Conventional Radiocarbon age		2 sigma (95%) Calibrated age range	2 sigma (95%) Dillingham Bayesian age range	Modelled Stratigraphy
	Yrs BP	1σ error			
OZK328	245	40 +-	0-430 BP (1520-1950 AD)	160-300 BP (1650-1790AD) 60-75% probability it began after 280 BP (1670 AD)	Occupation Phase 2
OZK327	465	100+-	159-640 BP (1310-1791 AD)	330-540 BP (1410-1620 AD) 60-75% probability it began after 450 BP (1600 AD)	Occupation Phase1
OZK329	390	30 +-	320-480 BP (1470-1630 AD)	330-490 BP (1460-1620 AD) 60-75% probability it began after 280 BP (1600 AD)	Occupation Phase1

Model Based Results

The results of this Bayesian modeling suggest that there are two clear phases of occupation with the earliest [Occupation Phase 1] separated both stratigraphically and chronologically from the latest [Occupation Phase 2]. Occupation phase 1 (OZK327 & 329) is the earliest evidence of occupation in the cave, beginning between 330 BP and 560 BP (95% posterior probability), with a 60-75% probability that it began after 450 BP. Occupation phase 2 (OZK328) is the latest occupation beginningbetween 175 and 310 BP (95% posterior probability), with a 60-75% probability that it began after 280 BP. This date range is not significantly different to Occupation Phase 3 on the cave surface, defined by European pig bone that was probably deposited between 1805-1823 AD (Chapter 4).

Conclusion

Using only calibrated age ranges to 95% the three radiocarbon determinations all overlap and so cannot be statistically separated. However the Bayesian modeling tightens the ranges and allows for a two phase occupation that can be statistically separated (Table 5.16, Figure 5.40).

From the surface down, the archaeological stratigraphy found in cave site R06-17 supports the idea that Occupation Phase3 (the cave surface) is a late prehistoric event that extended into the historic period, as is shown by the presence of two European pig bones on the cave surface [Point OBJ 1011 & 1784]. This is consistent with a calendar date range of 1800-1830 AD, a period before significant European material culture infiltrated Māori society.

Below this, Occupation Phase 2 follows the same sloping orientation as the proto-historic phase 3and contains similar artefactual material. This suggests it may be contemporary with it, however there must be some time gap or some functional change to explain the small build-up of sterile material between the two phases. Occupation Phase 1 is interesting. The presence of fishbone and gourd seeds here and also in the surface in Occupation Phase 3 again shows no clear difference in the nature of the portable material culture recovered. However there are important stratigraphic differences. First, the cultural material of Occupation Phase 1 is physically separated by multiple sterile ash layers from the material found in the upper Occupation Phase 2. Second, OccupationPhase 1has a level horizontal orientation similar to the natural layers below as opposed to the sloping cultural material found in phases 2 and 3 above. This is consistent with Occupation Phase 1 reflecting the first human occupation in the cave.

The excavation units in Cave/Rock Shelter site R06-17 have uncovered an intact stratigraphy that implies some degree of time depth in its human occupation. Although all occupation phases are clearly of Māori origin (the 'who' question) and these extend into the historic period (the end part of the 'when' question), the presence of two sloping cultural horizons at the top of the stratigraphy separated by sterile bands of ash from one non-sloping cultural horizon at the bottom suggests that some major functional and/or chronological change separates the Occupation Phase 1 from Phases 2 and 3. Radiometric determinations modified by Bayesian statistics provide a different story. They suggest that the earliest occupation was Phase 1, that thisoccurred after 450 BP (60-75% probability), and that it is not significantly different from that found in Phase 2. The difference occurs between Phases 2 and 3, with the surface Phase 3 material dating to after 280 BP (60-75% probability)(Appendix 8:iv).

5.2.4 Gardening

In 2005 and 2006, a series of small scale excavations were carried out on two of the largest of the 12 garden areas recorded on Tawhiti Rahi Island (Figure 5.41). Locations chosen were site R06-90 in the North-East Garden (Geographic area 4 -Central ridge north), and R06-13 in the East Garden (Geographic area 7 - East stream valley). Stone and earthwork features were examined to understand their construction and to confirm their function as garden structures (the 'why' question). When possible, suitable charcoal samples were taken for radiometric dating, in order to place the gardens into calendar time frame (the 'when' question).

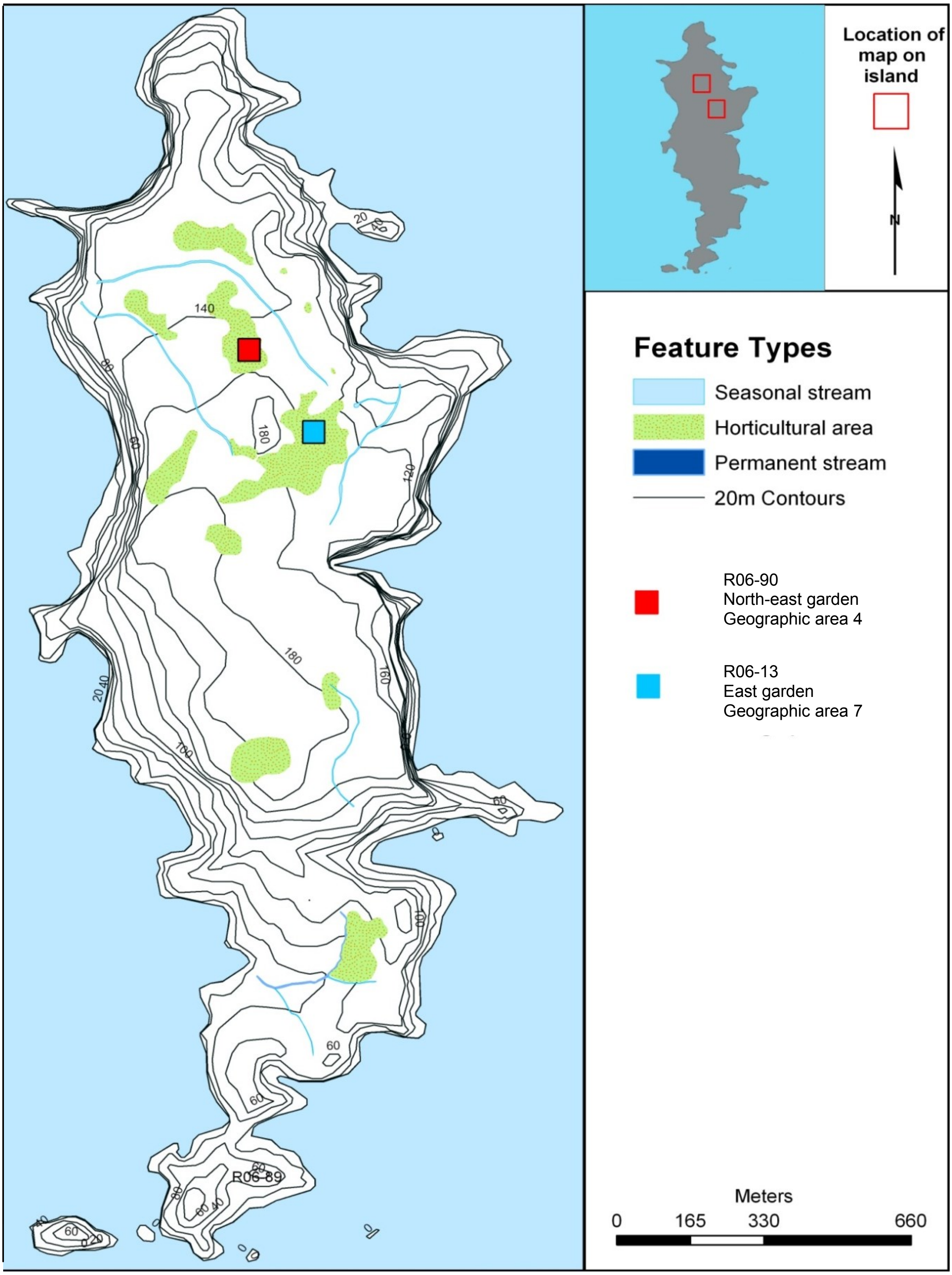


Figure 5.41 Excavations 1 and 2 at R06-90 (North-East Garden), and Excavation 3 at R06-13 (East Garden).

5.2.4.1 North-east garden (R06- 90):

This site, described in Chapter 5 Part I, is located on the northern end of the high plateau that forms the northern part of Tawhiti Rahi Island. It is found in Geographic area 4, on the north-eastern slopes of the central north running ridge that separates western and northern valley systems (Buller Stream and the Meander River respectively). This series of investigations is focused on a 100 m x 220 m cluster of stone and earth structures that are thought to be garden related features on the northern slope of the ridge that runs down to the Meander River. Recorded as site R06-90 and colloquially referred to as the 'north-east garden', two small test pit excavations (Figure 5.42) were carried out here on representative stone features so as to understand their internal structure, to determine their function and if possible, to obtain samples for radiometric dating.

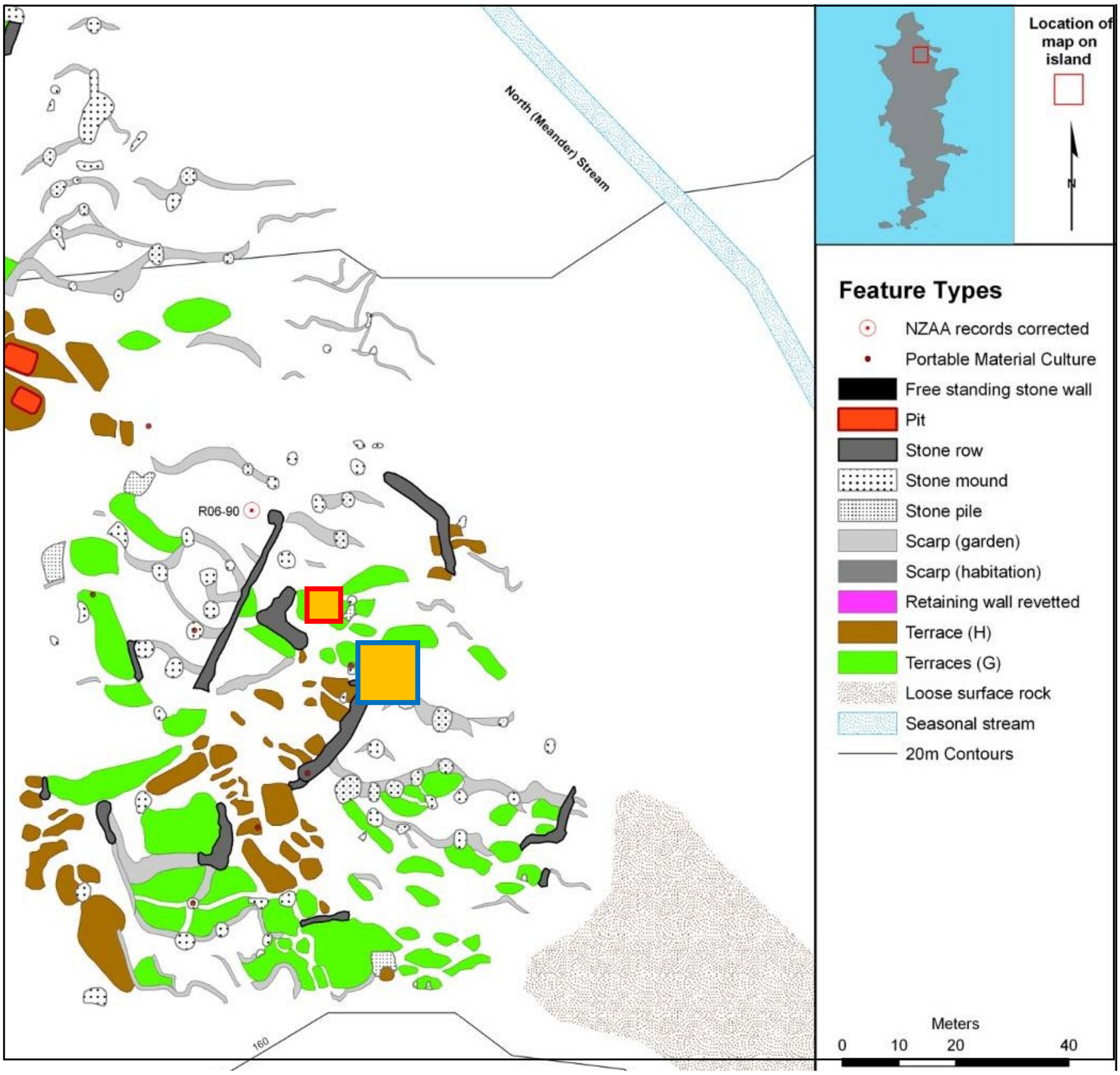


Figure 5.42 North-east garden R06-90: Excavation 1 is a stone mound [Feature OBJID 1608] on garden terrace site [Feature OBJID 811] (small RED SQUARE). Excavation 2 is at the northern end of a stone row [Feature OBJID 1754] and on an adjacent terrace [Feature OBJID 1761] (large BLUE SQUARE).

Excavation 1: Mound [Feature OBJID 1608]

This mound sits on the front edge of a small terrace [Feature OBJID 1761] and measures 2.4 m north to south, and 2.8 m west to east, and is less than 60 cm high (Plate 5.29; Figure 5.43). The western side has been broken open in the past presumably by displaced roots associated with a tree fall. The mound's construction involves large boundary rocks around at least part of the outside and much smaller rocks inside.

Plate 5.29 North-East garden R06-90, Excavation 1: North end of mound Feature OBJID 1608looking south prior to excavation. [Robinson2005; 063 10A]

A base line was strung up north-south across the mound and photos were taken of the feature. Test Pit 1, measuring 20 x 20 cm, was dug into the damaged section and when cleaned down, the eastern section of the test pit was drawn up. This cross section is included below as part of a section drawing that has been extrapolated through the whole mound (Figure 5.43). Measured from the southern side of test pit 1, four layers are described at depths below the string line.

Layer 1 (50-65 cm): Grouping of small stone with a larger single stone on the mound surface.

Layer 2 (65-73 cm): Light red/brown loamy topsoil with numerous rootlets.

Layer 3 (73-87 cm): Light brown mixed soil with white ash clumps.

Layer 4 (87-90 cm): Hard concreted basal white ash natural subsoil.

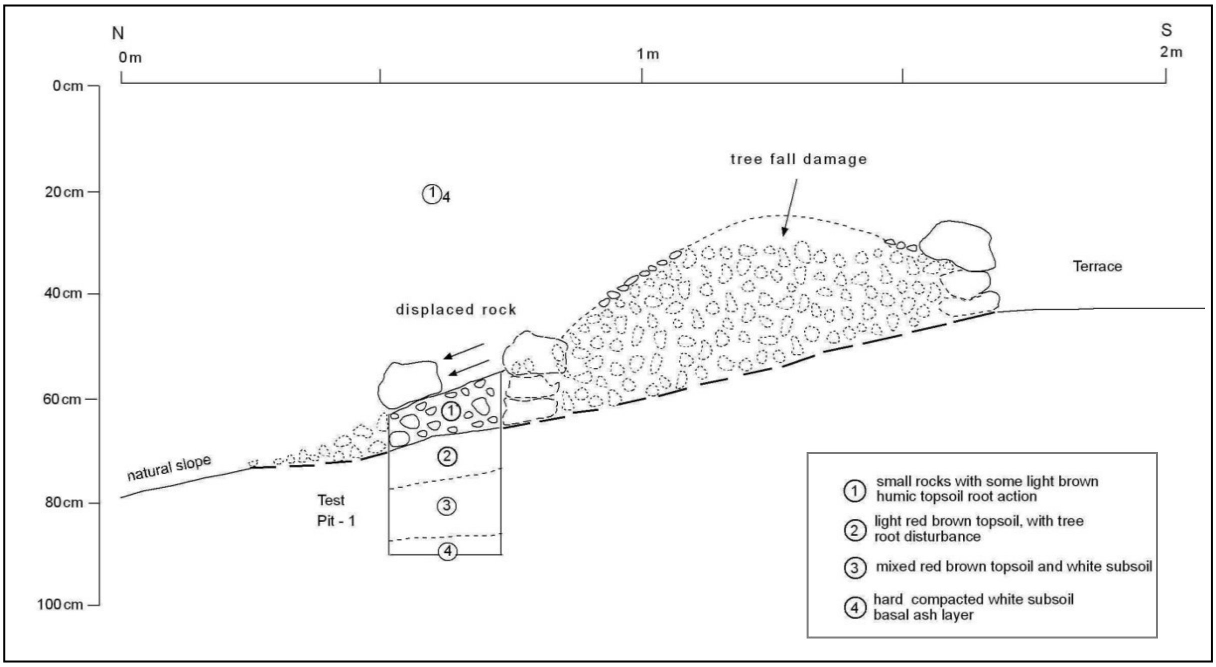


Figure 5.43 North-East garden R06-90, Excavation 1: Section drawing of Test pit 1 dug into stone mound [Feature OBJID 1608]. This section has been extrapolated from the test pit to include the whole mound.

Examination of the southern end of the above section drawing clearly shows the construction method whereby large stone were laid to form a circle one to three stones high and then smaller stone were 'mounded' within this retaining structure. The tree damage on the northern side has displaced at least one of the large retaining rocks and it and smaller stones have begun travelling down the slope. No portable material culture was identified from this test pit or from the immediate area around this mound. Similarly no charcoal suitable for dating was recovered.

For comparative purpose, a second test pit – Test Pit 2 - was dug 5.3 m to the south-south-west of this mound on the same terrace [Feature OBJID 1761]. This revealed a very different profile when measured down from the ground surface.

0-5 cm: Dark humic topsoil.

5-15 cm: A dark grey/brown soft clay soil.

15-30 cm: A layer of cobbles and stone.

Comment

This mound appears to be a surface feature constructed on top of an existing natural sloping soil profile that includes topsoil, mixed subsoil and a white volcanic ash base. This natural ash base is similar to the subsoil found in the Hearth excavation in that it has become concreted through water percolation. The small inner stones that form the core of the mound are associated with only small amounts of soil. This suggests that the mound is unlikely to have been directly cultivated. Instead it appears to be a structural feature associated with the clearing of adjacent loose surface stone where the actual cultivation occurred. Its location on the front edge of a terrace implies that it was made during or immediately after the terrace building process. The stratigraphy in the second test pit located on the associated terrace is completely different. The lack of any floor or cultural horizon suggests that it had a cultivation rather than a habitation function. If correct the dark grey/brown layer may be a horticultural soil while the cobbled surface below it could be hard pan designed to stop kumara tubers 'bolting' and instead to encourage them to bulk out with carbohydrates (Coleman, 1972).

Excavation 2: Stone Row [Feature OBJID 1754]

Located approximately 30 m to the south of excavation 1 is a stone row that extends for 25 m in a northerly section down a gentle slope. Excavationfocused on the northern 'toe' end of this stone row [Feature OBJID 1754] and included part of a terrace that abuts its western side. The row is well preserved and its construction involves 2 tiers of large boundary rocks on the eastern side and three on the western side, while the north end of the row has a sloping face of irregularly laid large rocks. In the 1.5 m wide area between the tiers there are numerous smaller rocks that reach a mounded height of 0.5 m.

The northern 6 m of this row was cleared of loose leaves, low shrubs and dead branches (Plate 5.30). A base line was set up at right angles to the line of the row and three test pits were dug. Two of these test pits were excavated hard up on the immediate western and eastern sides (Test pits 1 and 3) while a central test pit (Test Pit 2) was dug on the top of the row (Plate 5.31). At a point 4 m south of and upslope from the northern end of the row, there is a small terrace [Feature OBJID 1761] on the west side on which a fourth test pit (Test pit 4) was excavated. A plan drawing of the row and section drawings of three of the four test pits were made (Figure 5.44).

Stratigraphically,Test Pits 1 and 3 are broadly similar to each other. Test Pit 1 to the east has a root filled black soil (L1a), a light black soil (L2) alight orange/brown ash soil (L3) and a brown/whitecompactedashsubsoil(L4). Inadditiona number of fist sized stones were encountered in L2 and L3. Test Pit 3 to the west has similar root filled black soil (L1b), black fine soil (L2), alight orange/brown ash soil (L3) and - just exposed in the base of the test pit – a similar subsoil of white and brown hard ashy material (L4). The most obvious difference is that unlike test pit 1, layers 2 and 3 of Test Pit 3 contained few rocks. Test Pit 2on the other hand differs markedly from Test Pits 1 and 3. Located on top of the row between Test Pits 1 and 3, it consists of a single layer of roots and medium brown soil in a matrix of small rocks (L5). For

Plate 5.30 North-East garden R06-90, Excavation 2: North end of stone row.[Feature OBJID 1754]. Looking south prior toexcavation. [Findlater 0604130012]

Plate 5.31 North-East garden R06-90, Excavation 2: North end of stone row [Feature OBJID 1754]. Looking north showing test pits 1-3. Terrace Feature OBJID 1761 lies left of the coat.[Robinson 0604130112]

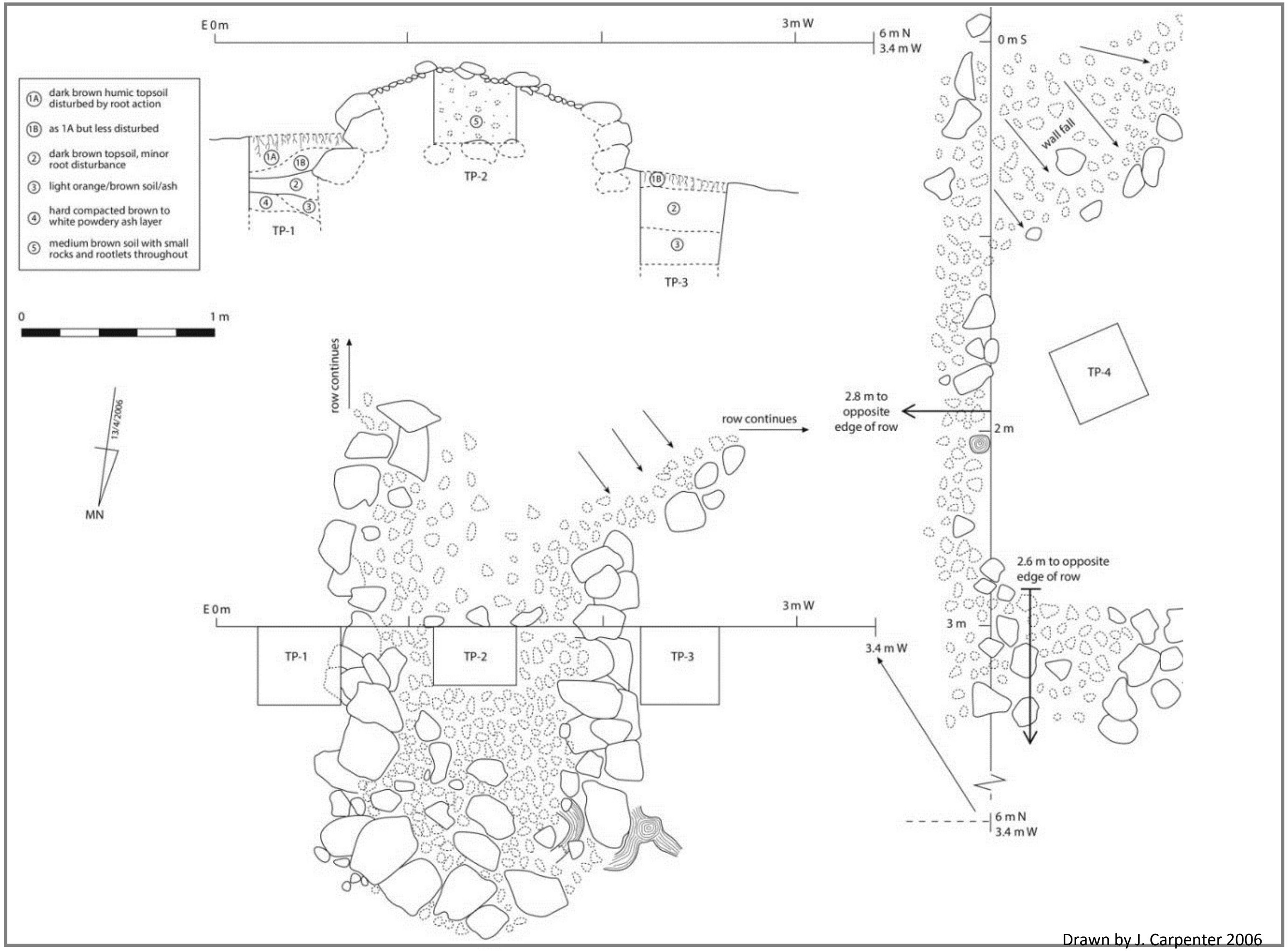


Figure 5.44 North-East garden R06-90, Excavation 2: Stone row [Feature OBJID 1754]. Section and plan of the northern end of the row showing test pits 1-4.

comparative purposes Test Pit 4 was dug 4 m to the south from the toe of the stone row, on an adjacent terrace. This showed a shallow profile of silty black stone free topsoil over a hard white ashy subsoil.

In an attempt to date the construction of this stone row, some unidentified charcoal was floated from a soil sample taken from L2 in test pit 3 immediately below the row's foundation rocks. Radiocarbon determinations for this sample dated it to 2060+- 28 BP,with a calibrated 95% date range of 100BC-80AD (Appendix 8v). This sample might be anthropogenic only if the charcoal was from a very long lived tree (1400 years old) that was burnt early in the prehistoric sequence (circa 1300AD). However, it is much more likely that this charcoal originated from an earlier natural burn event that occurred prior to human modification of this island, and in that case, a determination of a calendar date for the construction of this stone row is not possible.

Comment

The excavation supports the idea set out in the Ch 5 part I that the stone rows are associated with some form of social and/or practical garden boundary. The function of these rows needs further investigation.

Within the context of the general catchment slope that drops down to the East Stream valley floor, this garden contains a number of scarps. Most of these run across this slope and reduce the steepness of the natural contour by creating a series of steps of gentler slope that presumably assist in garden cultivation by retaining ground moisture. A smaller number of scarps run down the slope and one of these was identified during this excavation under this large row that required three courses of rock to the west but only two to the east. It is unclear whether this down slope scarp is natural in origin or man-made, but the row has the effect of 'leveling' it out.

5.2.4.2 East garden (R06- 13)

This site is described in Chapter 5 Part I as part of geographical area 7 East (Astelia) Stream valley. It is located on the east side of the central ridge on the high plateau on an east sloping catchment between Puketuaho Hill to the west and the East (Astelia) Stream to the east. Although components identified in site R06-13 include habitation terraces to the west on the foothills of the central ridge, and the major rock depository and possible quarry site to the north, this series of investigations is focused on an extensive cluster of what are thought to be garden related features (Figure5.45).

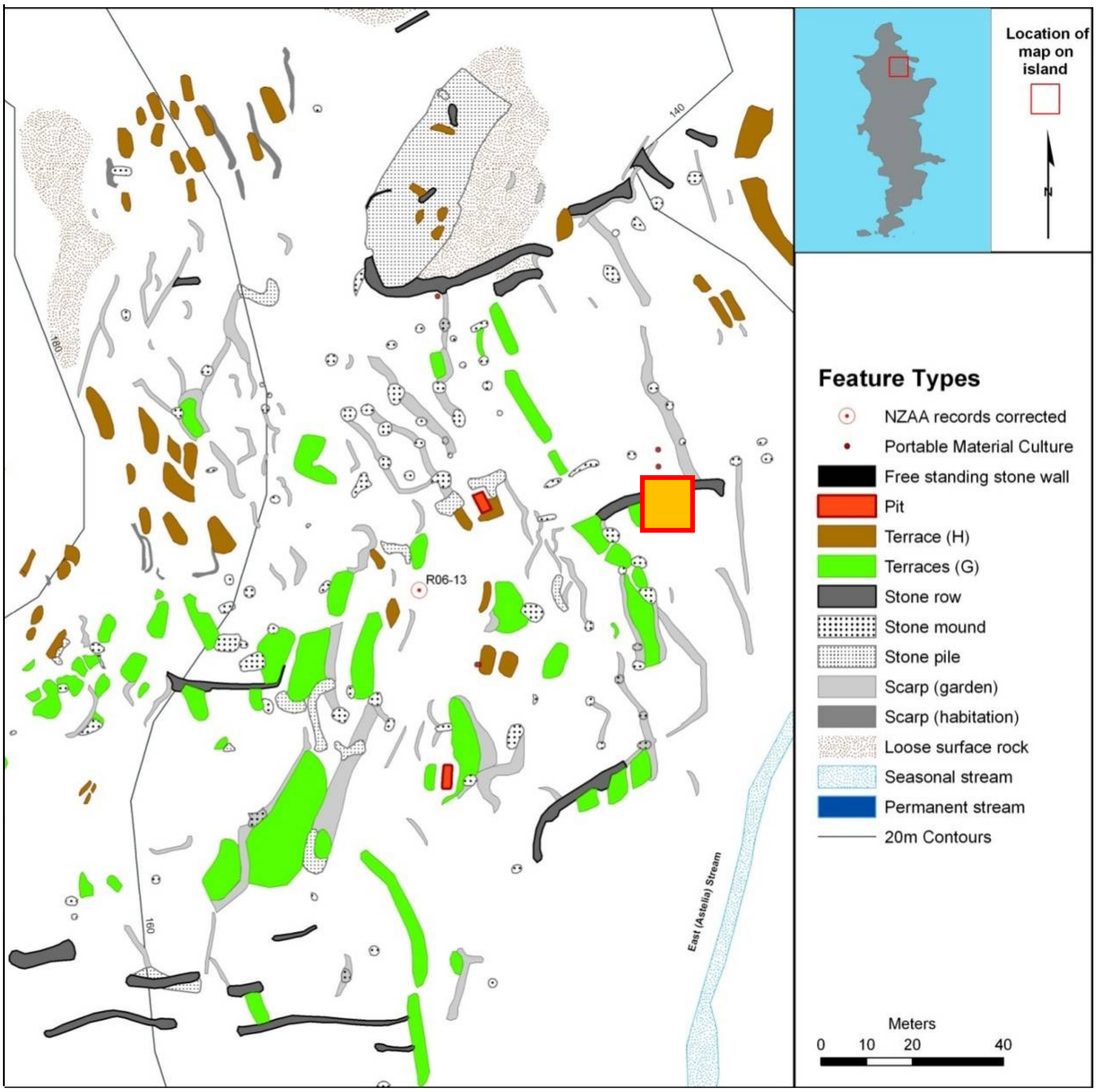


Figure 5.45 East garden R06-13, Excavation 3: In the East garden this investigated focused on the north-east end of a Stone row [FeatureOBJID 810], a mound [Feature OBJID 811] and two associated terraces [Feature OBJID 813&814] [RED SQUARE].

Here in a 200 m by 220 m area are found 17 stone rows, 105 garden or habitation terraces, 102 stone mounds, 110 stone faced scarps and 13 stone piles. As with most feature groups thought to be gardens, only a few items of portable material culture were identified, comprisingthree obsidian pieces, and two siliceous rhyolitic rocks. These garden features cover most of site R06-13 and are referred to as the ‘East garden’. Test pits were excavated here on the central part of a stone row, and on an adjacent stone mound feature. The investigation was aimed at understanding their structure, determining function, and to obtain samples for radiometric dating.

Excavation 3: Stone Row [Feature OBJID 810] and Stone Mound [Feature OBJID 811]

This excavation is located on a 10 x 10 m area containing a cluster of features. The primary feature is a stone row extending for 28 m in a north easterly direction down a gentle slope [Feature OBJID 810]. Two small 4 m long south-west oriented terraces 7 m apart abut the row on its south-east side [Feature OBJID 813 & 814]. On the upper most of these terraces there is a small intact stone mound built on its front scarp [Feature OBJID 811]. Base line 1 was set up at right angles to the line of the row and extending south-east for seven meters. Base line 2 was set up parallel to the row starting from the south-east end of base line 1 on the lower terrace and running up slope for 10 m across the stone mound and ending on the upper terrace. Three test pits (1-3) were dug on base line 1 and one test pit (4) dug on base line 2 in the mound (Figure 5.46).

Stone Row

This row is not as well preserved as the one previously excavated in site R06-90, and although its construction is broadly similar (parallel lines of large boundary rocks containing piles of smaller stones that attain a height of 40 cm), all of the rock has been highly modified by destructive processes, and the row has partially collapsed outward. It is likely that laid stone of 2-3 coursesonce retained the inner small stones, but none of these laid stone still stand. The northern 10 m of this row was cleared of loose leaves, low shrubs and dead branches (Plate 5.32). Base line 1 was set up running north along the terrace and across the mid part of the stone row. Base line 2 starts at the southern end of baseline 1 and runs westwards up the slope and onto the upper terrace.

The first test pit (Test Pit 1) was excavated hard up on the immediate south-eastern side of the row on the lower terrace. A second (Test Pit 3) was dug hard up against the north-western side on the general valley slope. A third test pit (Test Pit 2) was dug centrally on top of the row. At a point seven meters along base line 2 the fourth test pit (Test Pit 4) was dug on the mound located on the upper terrace (Plate 5.33 RIGHT). A plan drawing of Excavation 3 row and mound (Figure 5.46), and section drawings of all four test pits (Figure 5.47)was made.

Test pits 1 and 3 have similar stratigraphy in their top three layers (Plate 5.33- LEFT). Test pit 1 has a surface scatter of small rock eroded from the adjacent damaged stone row. The top layer in this test pit is a fine brown humic soil full of roots and small stones (L1). Below this is a black/brown topsoil soil with roots (L2) along with occasional lighter ashy clumps that appear to originate from layer 3 below. Layer 3 is characterised as a light orange/brown medium coarse ash soil (L3). Visible in the base of both test pits is a yellow/tan powdery compact ash layer that is a

Plate 5.32 East garden R06-13, Excavation 3: Eastern section of stone row [Feature OBJID 811]. Base line runing north prior to excavation starting. [0604140126Robinson 2006]

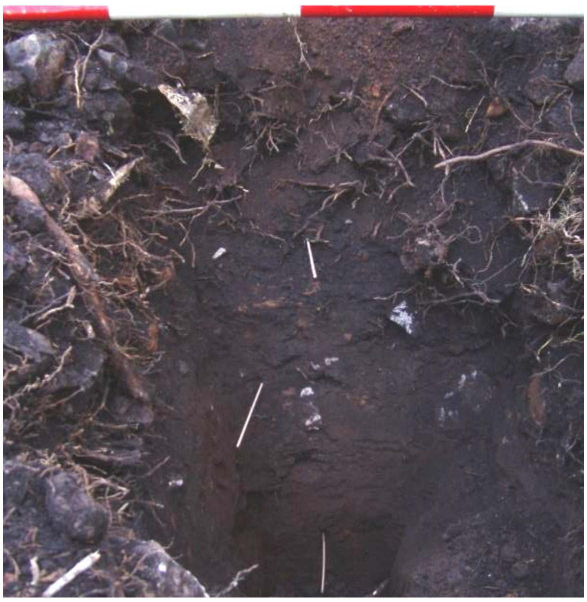


Plate 5.33 (LEFT): South baulk of Test pit 3 in stone row [Feature OBJID 810]. [0604140130 Robinson 2006]
(RIGHT): South baulk of Test pit 4 in the stone mound [Feature OBJID 811]. [0604140134 Robinson 2006].

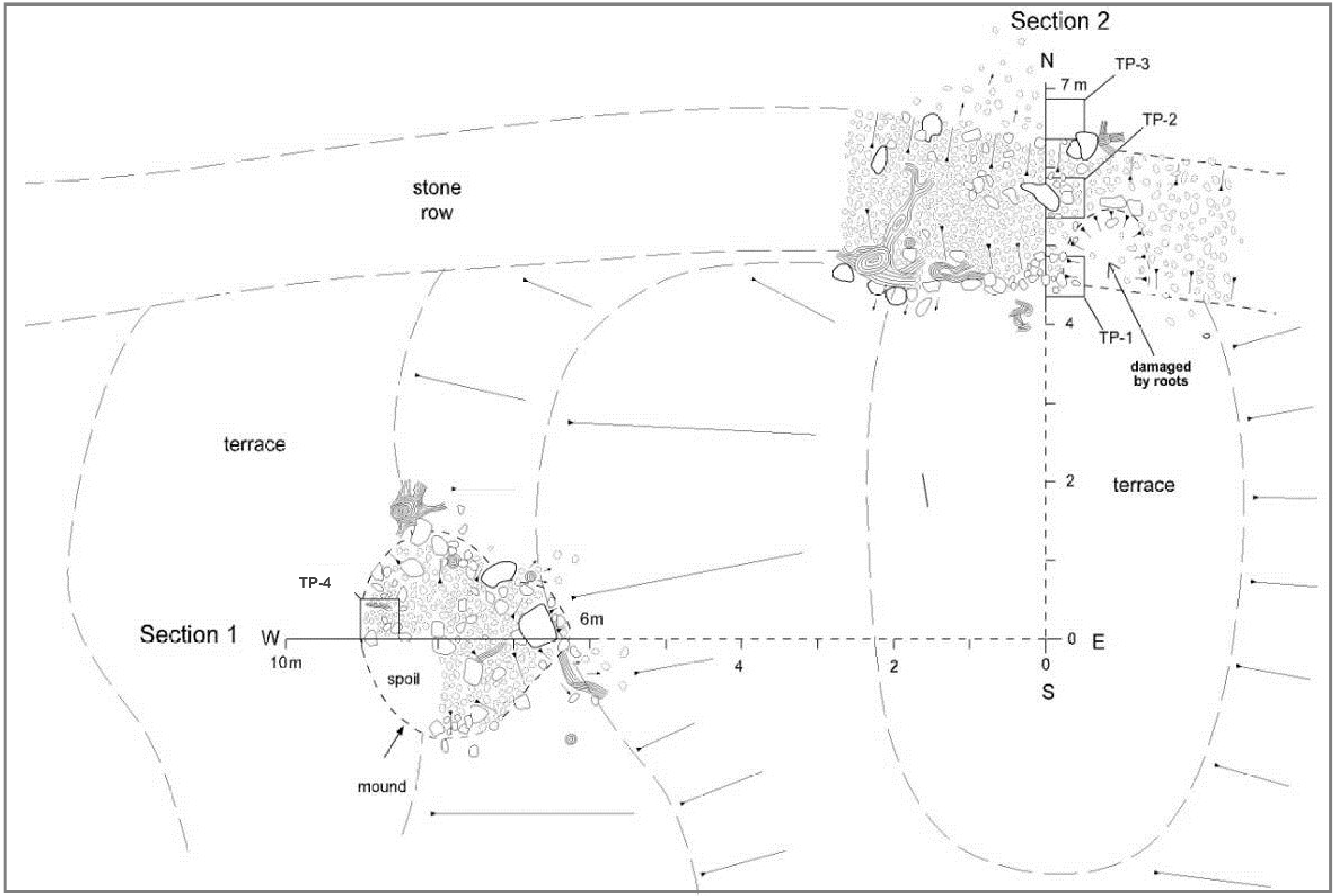


Figure 5.46 East garden R06-13, Excavation 3: Plan view (i) showing the middle part of stonerow Feature OBJID 810 and Test Pits 1-3 on the south-north baseline at 4-7 madjacent to terrace [Feature OBJID 814], and (ii)showing mound feature OBJID 811 and Test Pit 4 on the west-east baseline at 9-6 mon the edge of terrace [Feature OBJID 813]

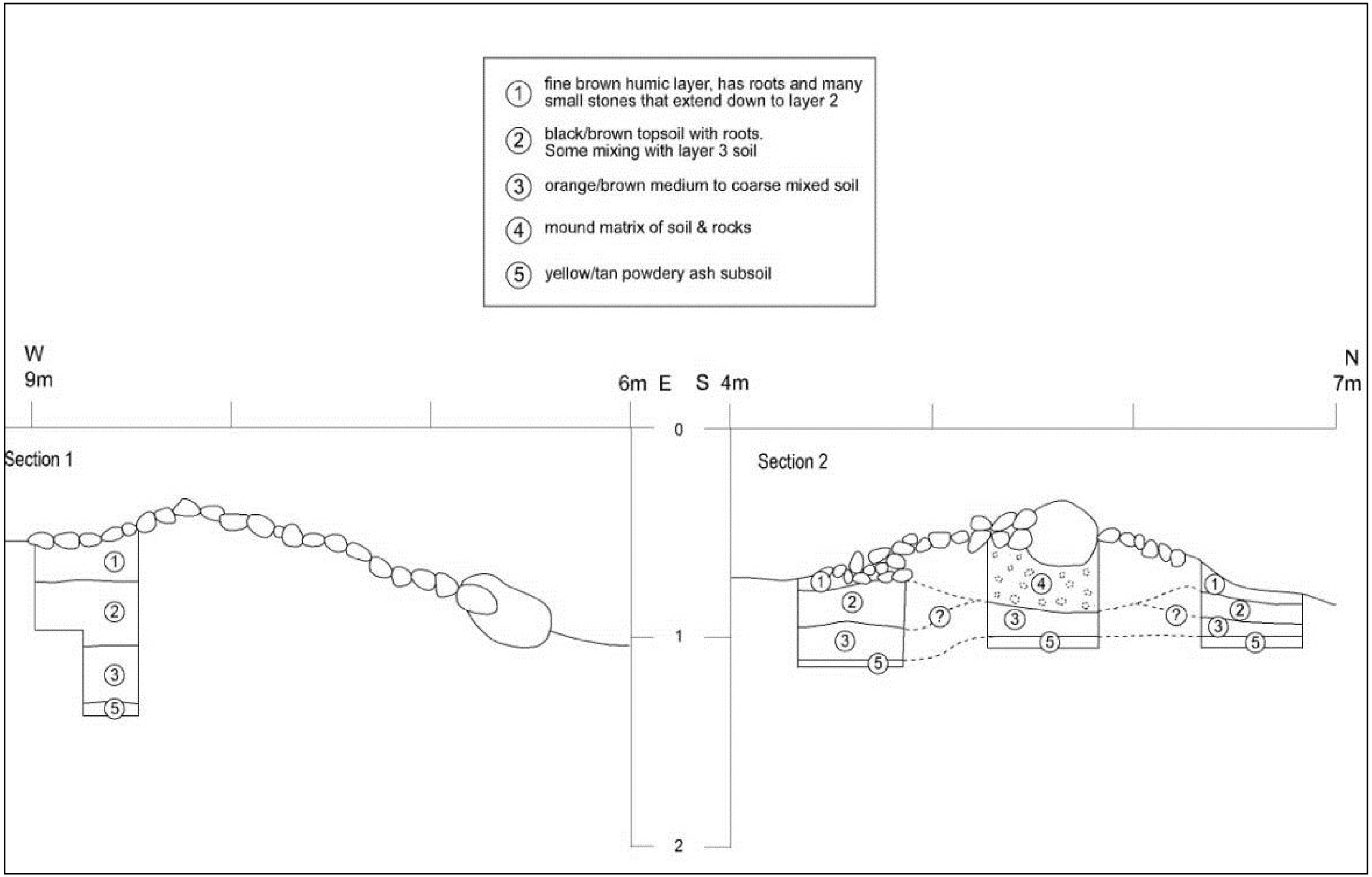


Figure 5.47 East garden R06-13, Excavation 3: Section drawings running west-east through mound Feature OBJID 811 showing Test Pit 4 (Section 1 LEFT), and north-souththrough stone row Feature OBJID 810 showing Test Pits 1-3 (Section 2 RIGHT).

natural subsoil (L5). The differences between these two test pits is that individual layers found in test pit 1 are significantly thicker than those found in test pit 2. This variation may be because test pit 1 was dug into a constructed terrace [Feature OBJID 814] while test pit 3 was excavated on an unmodified hill slope. The central test pit 2 on the other hand differs markedly from test pits 1 and 3. Located on top of the row between test pit 1 and 3 under a cap of in-situ larger stones, it is dominated by a 50 cm thick matrix of brown soil and small rocks (L4). Under this is a thinner layer of light orange/brown medium coarse ash soil (L3) that in turn overlays the compact powdery yellow/tan ash natural subsoil (L5).

No charcoal was recovered from the excavated soils under this stone row feature, therefore it was not possible to date the construction using radiocarbon determinations.

Comment

This stone row is one of the larger rows to be found in this east garden. Like many stone mounds, it was originally built with an outer layer of large stones and an inner fill of small stones and earth. By chance this row has suffered significant erosion presumably from tree roots and tree fall actions and so it is not possible to determine if the larger rocks were set in laid courses. The curved base of layer 4 in the central test pit 2 implies that the row was built on a 'scoop' set into the ground. The absence of layer 2 within the row suggests that this was the material removed to form the 'scoop'. Thicker layers found to the south of the row reflect the presence of a constructed terrace while the thinner layers to the north presumably reflect a natural soil profile. When looking at the layer 5 compact volcanic ash subsoil it is found deeper to the south (50 cm below ground surface) and shallower to the north (30 cm below ground surface). This suggests that at least this part of the row was built on a slope change that occurs at right angles to the general slope of the garden that drops to the east.

Stone Mound

For comparative purposes test pit 4 was dug away from the stone row on a stone mound situated on the front scarp of an adjacent terrace 4 m to the south and 7 m to the west of test pits 1-3 (Plate 5.33RIGHT). The section showed a 1.3 m deep profile consisting of a fine brown humic soil full of roots and small stones (L1), black/brown topsoil with roots (L2), a light orange/brown medium coarse ash soil (L3) and a naturally occurring subsoil of yellow/tan powdery compact ash (L5). This profile is very similar to that found in test pit 1 on the terrace below,however each layer is significantly thicker.

Comment

This mound is one of many found in this garden that are located on the front scarp of a man-made terrace. Like the row, it has larger rocks on the outside but again this construction method has been obscured by the high degree rock displacement associated with tree root action and tree fall events. What is clear is that the underlying scarp is constructed from various soil layers built up over a meter high. Although these look the same as those found on the presumed natural hill slope (Stone row test pit 3), it is clear that these must have been man-made. The mound itself appears to be the last feature to be built on this terrace, whose structure is consistent with a horticultural rather than habitation function. As such the mound may reflect the removal of loose rock that was unearthed during the gardening process rather than during the earlier terrace construction process.

5.2.4.3 Gardening Discussion

Function (the 'why' and 'who' question)

This series of small investigations carried out in the North-East Garden (Excavation 1 and 2)and in the East Garden (Excavation 3) targeted stone rows, stone mounds, and by association any adjacent terraces. The results of these small excavations have identified presence and absence scenarios that suggest a garden function. There is an absence of nearly all artefacts, charcoal stained layers, faunal material or anything even remotely similar to the house floors and work floors found at the Hearth site (R06-24). Combined with the presence of these stone structures on the sloping sides of valleys protected from the weather, and with fertile silty soils that are well suited to cultivation, this suggests that these areas were used for gardening. Further support for this interpretation comes from other gardens recorded elsewhere in the Auckland/Northland region (Pouerua, South Auckland, Waipoua, and Whangaroa Harbour) which have very similar structural elements (Sullivan ND; Veart et al 1984; Sewell 1994; Bulmer 1989; Sutton et al2003).

Dating (the 'when' question')

It is unclear when the gardens were first made. Obtaining charcoal samples for radiometric dating was difficult and the one floated charcoal sample was probably contaminated with old charcoal. Direct and indirect evidence suggests that kumara, gourd and taro were grown on the island in prehistory. A half constructed row feature in the East garden (Plate 5.5; Feature OBJID1105) suggests that at least this garden was being expanded at the time the island was abandoned in 1823 (see History Chapter 3). The fact that the island was being used in the early historic periodraises the possibility that European crops such as white potato were being grown – but currently there is no structural evidence to support this.

Conclusion

These investigations show us how the structures were made and hints at how they relate to each other. Rows for example appear to have multiple functions including boundaries, rock clearance and direct gardening. In both examples from this study, gardens, rows provide a primary structure wherebythe large parallel rows run down slope and smaller rows run across slope to create strips that form 'rectangular gardens'. All other structural garden features relate to this framework.

These strips are consistently 30-40 m wide in the smaller North-East Garden and 50-60 m wide in the larger East Garden. Both have two to three adjacent strips that form the core of the gardens (see figure 5.29 & 5.34). The reoccurring presence of such strips elsewhere on this island and in other mainland localities (South Auckland, Pouerua Inland Bay of Islands) strongly suggests that the strips reflect social divisions associated with cultivation practices and/or ownership and/or use rights. Presumably constructed from adjacent loose rock originally located within the wider garden area, each has been deliberately placed on a slope change that runs across the general slope, and constructed with large outer walls that retain smaller stones on the interior. The garden excavations hint that at least some rows are constructed on lateral slope changes that run downthe valley slope, however the significance of this is currently unclear. The obvious implication of clearing stone from the ground is that the cleared ground is then used for cultivation. The presence of soil/small rock matrix inside the rows suggests that direct cultivation on such hybrid stone and earth structures is also possible (Coates 1992), but whether this occurred here is not known.

Stone mounds are the most significant of the secondary features in these gardens. They are clearly not boundaries, since they are consistently found within the framing structure of rows. They were deliberately made, and both the survey and excavations show that they are rarely found on the flat surface of terraces, but are more commonly located (i) on garden scarp features that form regularly spaced vertical slope changes that run across the valley slopes, or (ii) on the front or back scarps of garden terraces. Mounds themselves nearly all have some larger laid outer rocks retaining piles of smaller inner rocks. Damaged mounds and mounds that were investigated also have an internal soil matrix, so theoretically could have had cultigens planted directly on them. However we do not know how many of the mounds have an internal soil matrix, as its presence is not discernible from visual inspection, so currently we have no reliable method to determine if such cultivation practices occurred on Tawhiti Rahi. Like we found with stone rows, the indirect implication is that most cultivation would have occurred on the rock free sloping soils and level terrace soils in and around mounds and other built stone structures. As gardeners

Māori are known to grow multiple crops in their gardens and it is likely that they cultivated kumara in the large stone free areas. Since these cleared areas are interspersed with dense clusters of mounds it is possible that these were zones of intensive gourd cultivation, as was theorised by Sullivan in the similarly designed stone field gardens of South Auckland (Sullivan, 1974:140).

Terraces investigated in these gardens are structurally similar to those found in habitation sites such as the Hearth site (R06-24), and consist of both large and small level areas created by cutting back into a hill slope, depositing the resulting spoil in front and then retaining the resulting front scarp to create and stabilize the level terrace surface behind. These terraces occur in various groupings throughout the two gardens, and from surface evidence alone it is difficult to differentiate whether a given terrace has a garden or habitation function (H. Leach, 1976:114). Generally the interpretation of terraces as habitation areas is based on the presence of artefacts and charcoal stained soil, living floors or midden that can often be seen in erosion or excavations. The identification of gardening terraces is more difficult because it is primarily based on the absence of these clear cultural markers. What is interesting then is the variation in terrace soil profiles within gardens identified from this small scale investigation. Two very different soil profiles were recorded within the two terraces found in gardens R06-90 and R06-13 [Feature OBJID 814 & 1761]. These can be summarised as either shallow grey soils with a hard pan base, or deeper and darker coloured soils with a soft base. This variation could reflect different horticultural techniques being utilised and/or different cultivars - such as kumara or hue (bottle gourd) - being grown. For example, the shallow hard pan on one of the terraces is traditionally known to make kumara tubers 'bulk' out with carbohydrates prior to harvesting (Coleman, 1972).Alternatively, the deeper profile found on the other terrace along with the similar but shallower hill slope soil profiles, may have had a more complex relationship with the immediately adjacent stone mounds and rows that could have supported climbing cultivars such as bottle gourd. What is clear is that there is not enough information from this limited investigation to test this hypothesis further.

5.2.5 Summary of Part II

The excavations have confirmed that the archaeological landscape on Tawhiti Rahi Island has four functional area types, namely habitation, horticulture, specialist and ceremonial that are Māori in origin (the broad 'who' question). The dominance of what is confirmed to be gardens strongly supports the idea that the island's primary focus was horticultural, however the dramatic increase in volume of cultural material recovered from the surface of the cave hints that human use increased or became more intensive in the final period of occupation (the 'why' question).

Material recovered from these excavations including a small number of radiocarbon determinations, are consistent with late prehistoric settlement dated sometime after 1550AD through to historic times (the 'when' question).

The following section will analyse the portable material culture [5.3] recovered from the survey [5.1]and these excavations [5.2]. This may give some insight into where these islanders come from, the time frame of their presence on Tawhiti Rahi, and what links they had within the wider regional landscape.

5.3 Part III: Portable Material Cultural analysis

The recording of portable material culture is the third important component of the archaeological research program carried out on Tawhiti Rahi Island. As discussed previously the survey of Tawhiti Rahi Island has recorded an extensive, complex and near contiguous archaeological landscape of stone and earthwork structures, forming habitation, garden, specialist and ceremonial places. This is characteristic of the 'classic' (late) period of prehistoric Māori culture. The surface component of this cultural landscape remains remarkably well preserved due to the abrupt abandonment by Māori in 1823 and the lack of any subsequent human activity.

Scattered on the ground surface among these man-made structural features are extensive surface deposits of lithic, faunal (Figure 5.48) and floral material. The relation of these deposits of portable material culture in relation to the structural features on the island can inform us about site function, and indirectly about why people occupied the island. Where the material is not native to these islands, determining their source location can provide tangible connections to other mainland and island communities, and give us insights into towho these people were connected too. Sourcing and typology studies of the material can give further insight into when people occupied these islands. The portable material culture will be discussed in four sections: lithics [5.3.1], fauna [5.3.2], flora [5.3.3] and human remains [5.3.4]. The discussion begins below with an analysis of the lithic deposits.

5.3.1 Lithic analysis

A wide range of culturally utilised lithic material has been identified from the survey and excavations carried out on the Poor Knights Islands. This assemblage was entered into the GIS data base and includes small amounts of chert, dolerite, basalt, argillite, locally sourced white rhyolitic volcanic tuff and ochre. In contrast, large amounts of obsidian were identified. This lithic section therefore will have a primary focus on obsidian that will end with a summary of the visible characteristics and geochemical analysis and a discussion on what these studies have to say about the timing and nature Māori settlement on the Poor Knights Islands. The secondary focus of this section is on all other lithic material and/or artefacts recorded. Each will have a comment identifying in what way they can inform about the connections with other Māori communities.

Section 5.3.1.1 starts with an overview of the obsidian sampling methodology used and then gives the gross data analysis. The analyses of the obsidian data is approached in two ways with first a physical characteristics analysis followed by a geochemical analyses.

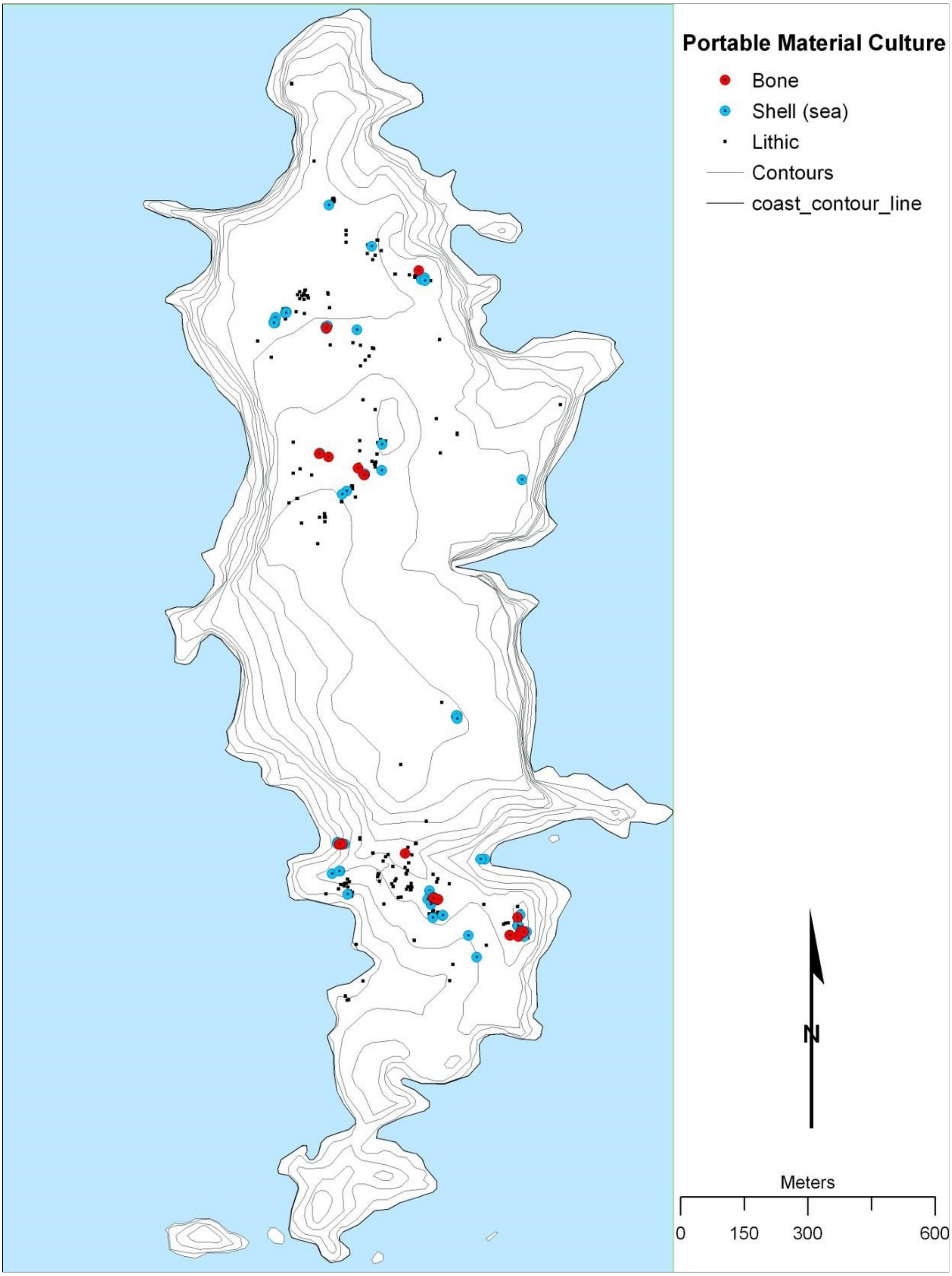


Figure 5.48 Distribution of lithic and faunal portable material culture on Tawhiti Rahi Island. [Note that the burials at sites R06-12 and 18 and the floral material in cave site R06-17 and Hearth site R06-24 are not shown].

The physical characterisation analysis starts with the creation of a typology and then compares this to the pattern of spatial and stratigraphic distribution. Finally a summary is given setting out how these obsidian physical characteristics studies can inform us about the timing and nature of Māori occupation. The geochemical trace element study involves two complementary x-ray florescence (XRF) studies. First a small high precision indicative study was made using both destructive and non-destructive XRF to attribute obsidian to source location. This will be followed by a large scale representative study using non-destructive XRF looking for sourcing patterns within the mid-north volcanic region* These geochemical studies can inform us about the timing and nature of Māori occupation on the Poor Knights Islands

In section 5.3.1.2 the nature and location of the other lithics, namely chert, dolerite, basalt, argillite, locally sourced white rhyolitic volcanic tuff and ochre will be examined. The nature and distribution of these lithic resources on the two primary islands in the Poor Knights group will then be discussed with regard to artefact types and lithic sourcing so as to understand where people came from, the timing of settlement and site function.

5.3.1.1 Obsidian

Background

The presence of prosaic quantities of obsidian on the surface of Tawhiti Rahi was commented on by previous archaeologists (Lawlor, 1979; Hayward, 1981; Leahy & Nichol, 1964). The visible distribution of obsidian was noted by the author on his first visit to Tawhiti Rahi Island in 1999. Subsequent visits reinforced the impression that there was a strong correlation between certain areas and the presence of obsidian. Once the various survey teams became familiar with the island environment, the distinctive 'glassy' characteristics of the obsidian made it readily recognizable amongst the leaf litter on the ground. The combination of this high visibility and the fact that the whole island needed to be traversed to record the structural archaeological features meant that the distribution of recorded surface obsidian is representative of what is present over the total surface of the island.

Sampling methodology

The sampling methodology used varied between isolates, small scatters and large obsidian clusters. Isolate find spots, scatters and clusters containing less than 100 artefacts were total sampled. A different sampling strategy was used for the three larger clusters. For two of the three clusters - R06-27 and R06-25 -, each utilised two transects crossing at right angles to each other,

* The mid-north volcanic region, is a subset of existing volcanic regions and sub-regions, and is defined later in section 5.3.1.1.

centered over the densest part of the deposits (Figure 5.49 and 5.50). Along these transects a series of adjoining 1 x 1 m squares were strung up and all the obsidian (along with all the other remaining portable material culture) found within these squares was collected. The remainder of the obsidian in the concentrations outside these squares was left in-situ. The third large obsidian cluster is part of site R06-24. This was sampled as part of an excavation and the sampling methodology used has been discussed in the previous excavation section 5.2.1.

Gross data analysis

A total of 851 obsidian artefacts weighing in total 7.663 kg were entered into the GIS data base, with the vast majority being from Tawhiti Rahi (844).For comparative purposes, a small sample of seven artefacts was collected from the adjacent Aorangi Island (7). This total assemblage included 588 obsidian artefacts that were surface collected during the survey fieldwork, 155 obsidian artefacts noted but not collected by the author during earlier surveys, and a further 118 obsidian artefacts that were recovered subsurface from excavations carried out at sites R06-12, R06-17 & R06-24. Obsidian artefacts were found either as isolated individual find spots or scatters or in 8 concentrated clusters (Figure 5.51). Five of the eight clusters contain between 22 and 57obsidian artefacts each, but the remaining three clusters at sites R06-24, R06-25 and R06-27 were much larger and contained 151, 136 and 281 obsidian artefacts respectively (Figure 5.52).

On a broad scale the obsidian located on the surface of Tawhiti Rahi Island is grouped into two discrete zones. The first zone is situated on the northern half of the large gently rolling plateau that forms the northern two thirds of the island and covers an area of approximately 400 x 850 m. The second zone covers roughly 530 x 470 m and is situated on the steeper but lower topography found at the southern quarter of the island. The obsidian in its original unmodified form appears as rounded cobbles that are "...generally rough to slightly water worn with only a few pieces having a smooth water-worn surface" (Appendix 4i, pg 2). Since the Poor Knights Islands lack permanent streams with high water flow or high energy shore lines that are required to produce such rounded cobbles, they must therefore have been imported to the island from some other location. Nearly all of these cobbles have been knapped by the islanders, but the resulting artefacts often retain some cortex (Table 5.17). Only cores, flakes, and debitage have been identified, and little evidence of reworking has been noted. Examination of the few remaining intact cobbles and the larger flake fragments with curved cortex still in place suggests that most cobbles ranged in size from 10-30 cm & weighed 20-210 g. The process of reducing these cobbles has created tool or waste flakes (585), worked cores (70) and non-diagnostic debitage (196). The debitage comes as irregularly shaped fragments or micro shatter.

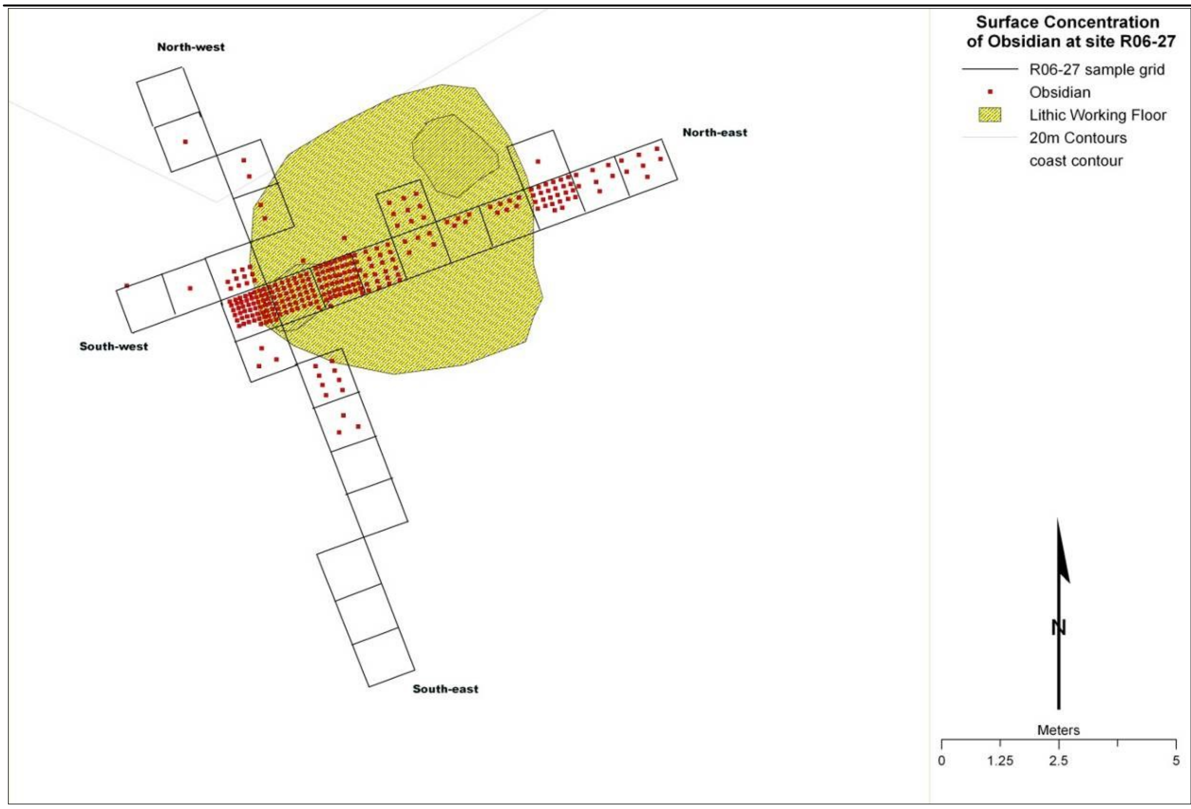


Figure 5.49 Extent of surface obsidian in concentration site R06-27, the location of the sampling grid & number of lithic artefacts GIS recorded within each 1 m square.

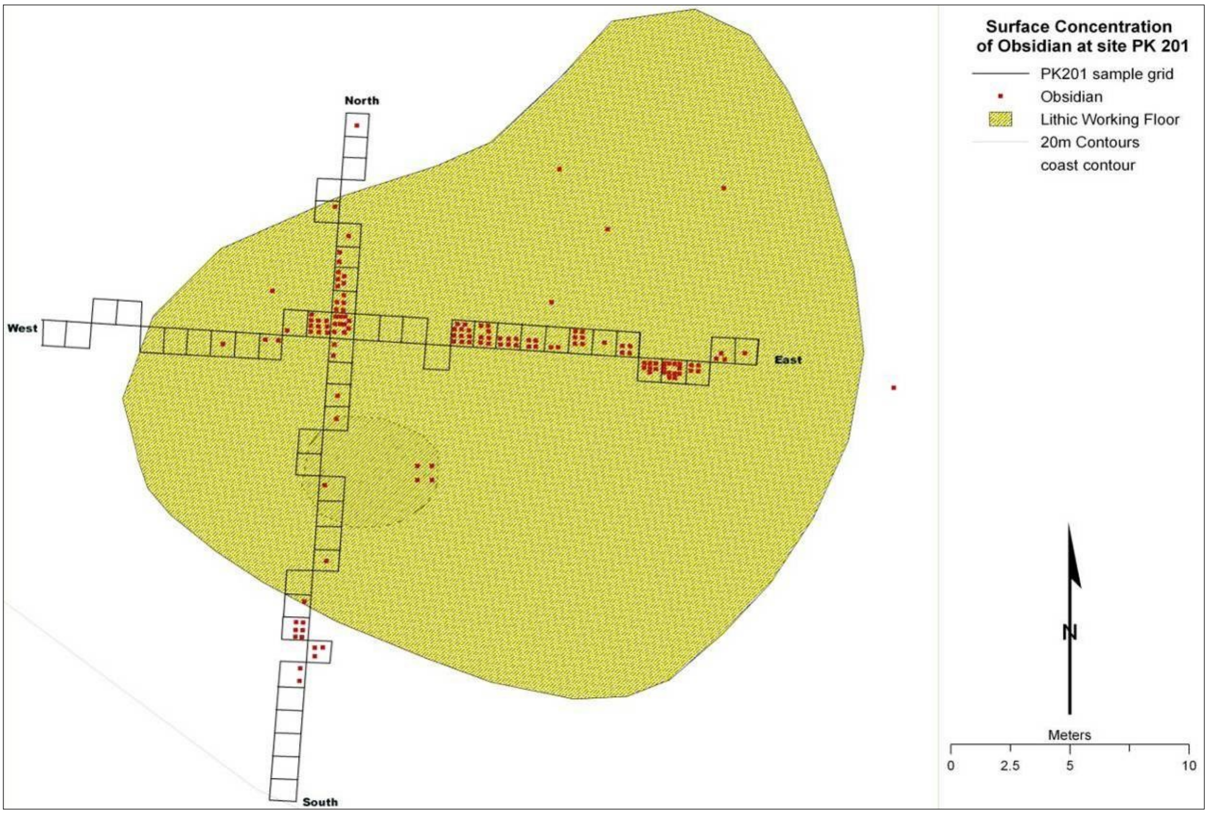


Figure 5.50 Extent of surface obsidian in concentration site R06-25 (PK201), the location of the sampling grid, and the number of lithic artefacts GIS recorded within each 1 m square.

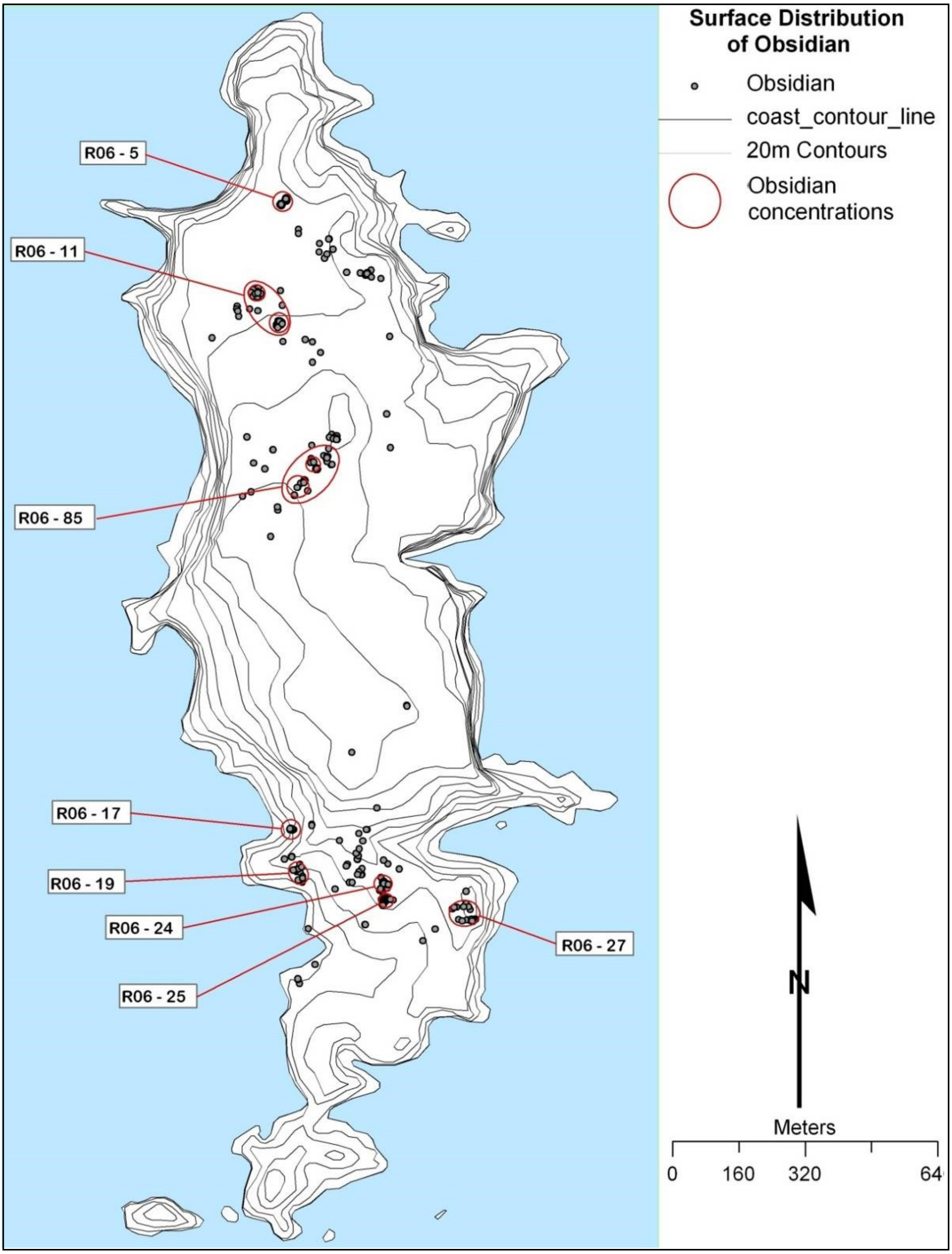


Figure 5.51 Obsidian distribution on Tawhiti Rahi Island. This is comprised of eight concentrations among the more numerous isolates and scatters.

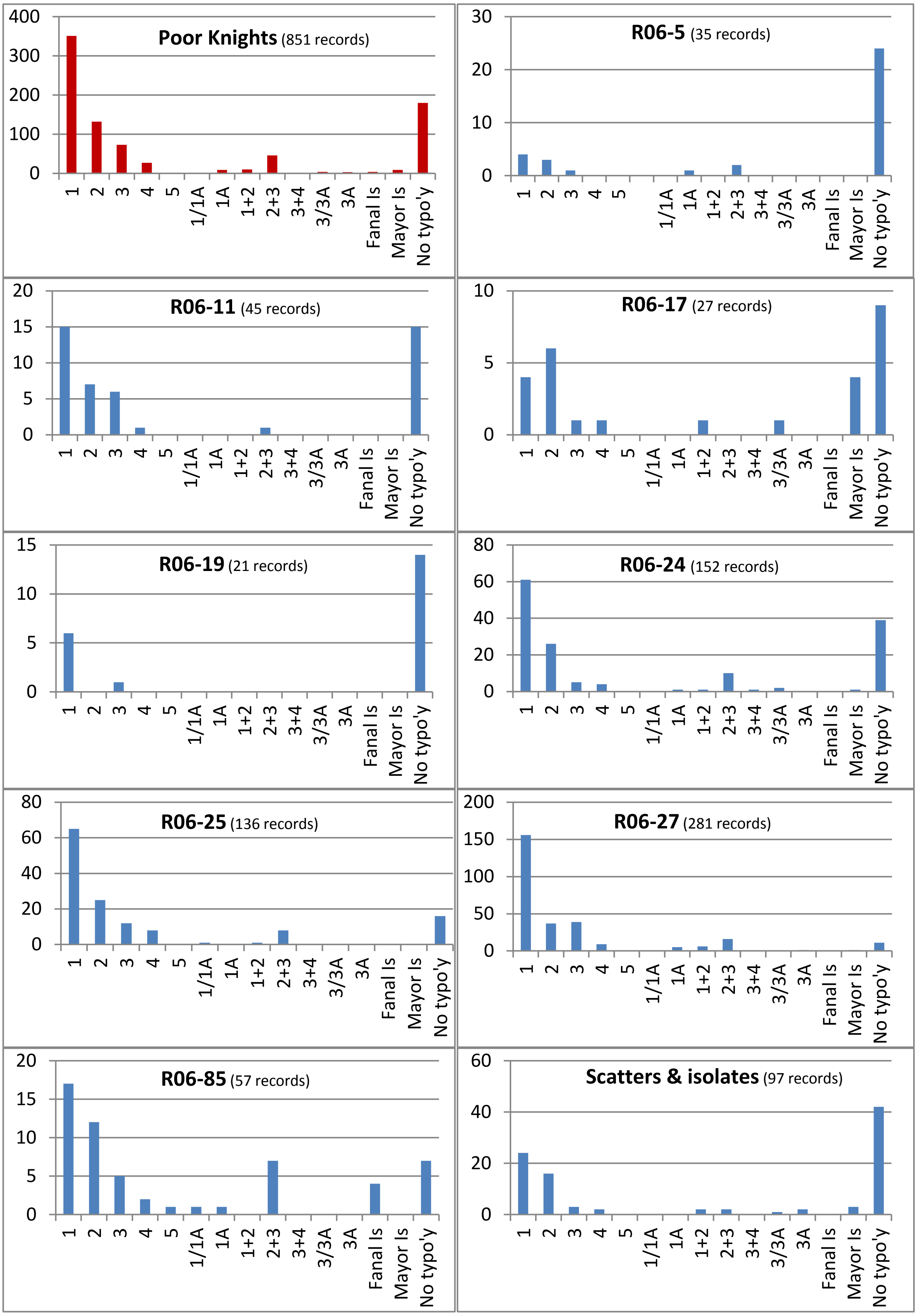


Figure 5.52 Ratio of obsidian types over the whole island (red) and then broken down into eight site concentrations (R06-5, 11, 17, 19, 24, 25, 27 & 85), and one group of isolates and scatters.

Table 5.17 Tawhiti Rahi obsidian: Percentage of cortex present in the assemblage of 851 obsidian artefacts.

<table>
<tr><th colspan="2"></th><th colspan="3">Cortex (number)</th><th colspan="3">Cortex (%)</th></tr>
<tr><th colspan="2">Recorded Sites</th><th>Present</th><th>Absent</th><th>Unknown</th><th>Present</th><th>Absent</th><th>Unknown</th></tr>
<tr><td>Aorangi Is</td><td rowspan="18">Isolates and small scatters obsidian collection (general collection)</td><td>3</td><td>3</td><td>1</td><td rowspan="18">52.0</td><td rowspan="18">18.4</td><td rowspan="18">29.6</td></tr>
<tr><td>R06-6</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>R06-8</td><td>4</td><td>6</td><td>0</td></tr>
<tr><td>R06-9</td><td>11</td><td>2</td><td>1</td></tr>
<tr><td>R06-10</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>R06-12</td><td>7</td><td>1</td><td>3</td></tr>
<tr><td>R06-13</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td>R06-14</td><td>6</td><td>1</td><td>1</td></tr>
<tr><td>R06-16</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>R06-18</td><td>2</td><td>0</td><td>0</td></tr>
<tr><td>R06-20</td><td>4</td><td>1</td><td>4</td></tr>
<tr><td>R06-22</td><td>2</td><td>0</td><td>12</td></tr>
<tr><td>R06-23</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>R06-28</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>R06-29</td><td>3</td><td>1</td><td>0</td></tr>
<tr><td>R06-89</td><td>2</td><td>0</td><td>0</td></tr>
<tr><td>R06-90</td><td>3</td><td>0</td><td>2</td></tr>
<tr><td>R06-91</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="2">Sub sub total</td><td>51</td><td>18</td><td>29</td><td>52</td><td>18.4</td><td>29.6</td></tr>
<tr><td colspan="2"></td><td>51</td><td>18</td><td>-</td><td>73.9</td><td>26.1</td><td>-</td></tr>
<tr><td colspan="2"></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">R06-5</td><td>23</td><td>2</td><td>10</td><td>65.7</td><td>5.7</td><td>28.6</td></tr>
<tr><td colspan="2"></td><td>23</td><td>2</td><td>-</td><td>92</td><td>8</td><td>-</td></tr>
<tr><td colspan="2">R06-11</td><td>29</td><td>6</td><td>9</td><td>65.9</td><td>13.6</td><td>20.5</td></tr>
<tr><td colspan="2"></td><td>29</td><td>6</td><td>-</td><td>82.9</td><td>17.1</td><td>-</td></tr>
<tr><td colspan="2">R06-17</td><td>14</td><td>12</td><td>1</td><td>51.9</td><td>44.4</td><td>3.7</td></tr>
<tr><td colspan="2"></td><td>14</td><td>12</td><td>-</td><td>53.8</td><td>46.2</td><td>-</td></tr>
<tr><td colspan="2">R06-19</td><td>8</td><td>1</td><td>13</td><td>36.4</td><td>4.5</td><td>59.1</td></tr>
<tr><td colspan="2"></td><td>8</td><td>1</td><td>-</td><td>88.9</td><td>11.1</td><td>-</td></tr>
<tr><td colspan="2">R06-24</td><td>88</td><td>50</td><td>13</td><td>58.3</td><td>33.1</td><td>8.6</td></tr>
<tr><td colspan="2"></td><td>88</td><td>50</td><td>-</td><td>63.8</td><td>36.2</td><td>-</td></tr>
<tr><td colspan="2">R06-25</td><td>63</td><td>71</td><td>2</td><td>46.3</td><td>52.2</td><td>1.5</td></tr>
<tr><td colspan="2"></td><td>63</td><td>71</td><td>-</td><td>47</td><td>53</td><td>-</td></tr>
<tr><td colspan="2">R06-27</td><td>212</td><td>63</td><td>6</td><td>75.5</td><td>22.4</td><td>2.1</td></tr>
<tr><td colspan="2"></td><td>212</td><td>63</td><td>-</td><td>77.1</td><td>22.9</td><td>-</td></tr>
<tr><td colspan="2">R06-85</td><td>31</td><td>21</td><td>5</td><td>54.4</td><td>36.8</td><td>8.8</td></tr>
<tr><td colspan="2"></td><td>31</td><td>21</td><td>-</td><td>59.6</td><td>40.5</td><td>-</td></tr>
<tr><td colspan="2">Sub total</td><td>468</td><td>226</td><td>59</td><td>62.2</td><td>30</td><td>7.8</td></tr>
<tr><td colspan="2"></td><td>468</td><td>226</td><td>-</td><td>67.4</td><td>32.6</td><td>-</td></tr>
<tr><td colspan="2">TOTAL</td><td>519</td><td>244</td><td>88</td><td>61</td><td>28.7</td><td>10.3</td></tr>
<tr><td colspan="2"></td><td colspan="3">851 artefact assemblage</td><td colspan="3">100%</td></tr>
</table>

Visual Characteristics Analysis

An initial assessment of the obsidians visual characteristics was made during the fieldwork program, and this identified a marked dominance of 'grey' obsidian (98%) in the assemblage. This 'grey' obsidian looked similar to obsidian originating from Great Barrier Island, located 85km to the south-east (Tatton per's comm.2000). Subsequently a systematic assessment of the obsidian's physical characteristics was made by geologist Dr Phil Moore to create a typology. This typology used criteria previously developed by Moore that included colour in transmitted and reflected light, degrees of translucency, and the presence or absence of flow banding and colour banding (Moore 1988). Crystal inclusions (phenocrysts) were also used as criteria, however these were only found in four samples in the assemblage. Moore's typology initially developed in 2007 and refined in 2009, identified four groups (A-D) containing seven 'morphs' or types of obsidian. Moore's typology is set out in Appendix 4(i) and summarised below.

Moore Obsidian Typology

Group A contains only Type 1 of unidentified obsidian (371 examples).

- Type 1 is dominant. It is dark grey to black in reflected light, grey to greenish grey in transmitted light, translucency is moderate to poor and flow-banding is mostly moderate to strong and dark grey/grayish black colour banding is common. This group contains the dominant type 1and its rare variant type's1/1A and 1A. 17 samples contain occasional spherulites. In addition there is a gradational category between types 1 and 2 called 1+2.

Group B contains obsidian Types 2 to 5 of unidentified obsidian (287 examples).

- Type 2 is relatively common and is generally black or dark grey to black in reflected light, brownish in transmitted light, translucency is moderate, and flow banding is generally weak to moderate and slight black/dark grey colour banding is common. In addition there is a gradational category between types 2 and 3 called 2+3.

- Type 3is uncommon. It is black in reflected light and brownish in transmitted light. Translucency is moderate to and flow banding is weak. Very rarevarianttypesinclude3/3A and 3A. In addition there is a gradational category between types 3 and 4 called 3+4.

- Type 4 is relatively rare. It is black in reflected light, and has a strong to moderate brown colour in transmitted light. Flow banding is weak apart from a few strongly banded pieces. In addition Moore identified intermediate categories of 1+2 (relatively rare) and 2+3 (uncommon).

- Type 5 is very rare being represented by only one sample [Point OBJ-217]. It is red with black streaks in reflected light however it has very poor translucency so no assessment of transmitted light colour can be made.

Group C contains unidentified obsidian (4 examples).

- This unidentified type is rare. All four samples were surface collected from site R06-85. These samples are grey/black in reflected light. They have moderate translucency and are grey in transmitted light. Unlike all the other obsidian recorded from the Poor Knights Islands, these are characterised by high proportions of crystal inclusions (phenocrysts) along with common globules.

Group D contains identified obsidian (9 examples).

- All are a fine grained black in reflected light. In addition, all have a distinctive olive green colour in transmitted light that is characteristic of Mayor Island obsidian.

Group 'No Typology' contains samples that were not analysed to the Moore typology (181).

- No description available.

Despite a number of visual differences noted in the physical characteristics of this obsidian assemblage, the presence of globules in types 1 to 5 led Moore to argue that obsidian Groups A and B originated from a single unknown source. Group C he argued was either a variant of this Group A and B, or an unknown source, or was from a related but also unknown source, while Group D was sourced to Mayor Island (Appendix 4i).

Obsidian spatial distribution and the Moore Typology

Out of the 851 obsidian artefacts entered into the GIS, 670 have been sorted into the Moore typology types (Table 5.18). If the 181 samples that were not identified into the Moore typology are excluded, then Group A type 1 makes up 52% of the assemblage. Looking only at Groups A and B types 1-5, this percentage increases to 87%. If the variants and gradients are included with types 1 to 4, then Groups A and B dominate this assemblage with 98%.The remaining 2% are found in Groups C and D and total only 13 artefacts.

Looking only at types 1, 2, 3 & 4 without variants they total of 583 obsidian samples and show a progressive dropping ratio of (13:5:3:1)over the whole of Tawhiti Rahi Island. These 583 artefacts are found in nine locations made up of eight sites with concentrations of obsidian and one amalgamation of the remaining isolate and scatter sites. On examination the progressive dropping ratio is clearly visible in six of the nine individual locations where these contain 35 or more artefacts (concentrations R06-11, 24, 25, 27, 85 & Scatters and isolates) and is partially visible in the three remaining locations (R06-5, 17 & 19) with less than 35 artefacts (see Figure 5.52).Clearly the higher the number of obsidian artefacts at a given site, the closer that location's ratio is to the island average (Table 5.19).

Table 5.18 Physical identification of Tawhiti Rahi and Aorangi obsidian using the Moore typology, from 8 site clusters and scatters/isolates.

		Site numbers R06-											
		5	**11**	**17**	**19**	**24**	**25**	**27**	**85**	**Scatters & isolates***	**TOTAL**	**%**	**% when 'no typology'is excluded**
Moore Typology													
Group	**Type**												
A	**1**	4	15	4	6	60	65	156	17	24	351	41.1	52
A	**1/1A**	0	0	0	0	0	0	0	1	0	1	0.1	.1
A	**1A**	1	0	0	0	1	1	5	1	0	9	1.1	1.3
A	**1+2**	0	0	1	0	0	1	6	0	2	10	1.2	1.5
B	**2**	3	7	6	0	26	25	37	12	16	132	15.6	20
B	**3**	1	6	1	1	5	12	39	5	3	73	8.6	11
B	**4**	0	1	1	0	4	8	9	2	2	27	3.2	4
B	**5**	0	0	0	0	0	0	0	1	0	1	0.1	.1
B	**2+3**	2	1	0	0	10	8	16	7	2	46	5.4	6.9
B	**3A**	0	0	0	0	0	0	1	0	2	3	0.3	0.5
B	**3/3A**	0	0	1	0	2	0	0	0	1	4	0.4	0.6
B	**3+4**	0	0	0	0	1	0	0	0	0	1	0.1	0.1
C	**-**	0	0	0	0	0	0	0	4	0	4	0.4	0.6
D	**Mayor**	0	0	4	0	1	0	1	0	3	9	1.1	1.3
No typology		24	15	9	14	42	16	11	7	42	181	21.3	-
TOTAL		**35**	**45**	**27**	**21**	**152**	**136**	**281**	**57**	**97**	**851**	**100**	**-**

Rows coloured in red are variant or gradational categories between types 1, 2 and 3.

*The 'isolates and scatters' group consist of obsidian found in sites containing less than 15 artefacts. In total 97 obsidian artefacts were recorded in 18 sites at an average 5.4 artefacts per site. Of these 97 artefacts, seven were located on the adjacent Aorangi Island while the remaining 91artefacts are exclusively found on Tawhiti Rahi Island within sites R06-6, 8, 9, 12, 13, 14, 16,18, 20, 22, 23, 28,

Table 5.19 Ratio of type 1 to 4 obsidian excluding variants and gradients as found in nine surface locations.

Sites	Artefact No.		Type 1%	Type 2 %	Type 3 %	Type 4 %
R06-19	7		86	0	14	7
R06-5	8		50	42	8	0
R06-17	12		33	50	8	8
R06-11	29		52	24	21	3
R06-85	36		47	33	14	6
R06-24	95		63	27	5	4
R06-25	110		59	23	11	7
R06-27	241		65	15	16	4
Isolates & scatters	45		53	36	7	4
All obsidian%	583		60	23	13	5
RATIO	(rounded)		13	5	3	1

<u>Obsidian stratigraphic distribution and the Moore Typology</u>

Having shown that the same ratio of type 1 to 4 obsidian is found spatially all across the island, we now look to see what the ratio of types 1 to 4 are when found 'vertically' from stratigraphic excavation. A total of four excavations were made on Tawhiti Rahi (see Chapter 5 section II), however only two (R06-17 & 24) contained enough obsidian to study, and only one produced significant results.

R06-17: The investigation of this cave site recovered a total of 27 obsidian artefacts with the majority (20) located on the surface and the remainder (7) from various depths within test pit 1 and trench 1(Table 5.20). The small sample size makes analysis problematic. However the surface material does broadly follow the island ratio – despite some minor inversion for types 1 and 2. The seven artefacts excavated subsurface were not categorised by the typology. Two of these can be hand sourced to Mayor Island by their olive green colour alone. The remaining five are grey samples that look similar to obsidian found on the cave surface. Although this is not a large enough sample to produce any significance results, it is of note that compared to the surface, very few obsidian artefacts were found underground. Obsidian from Mayor Island is found throughout the stratigraphy, and over half of all the Mayor Island obsidian (5 of 9) found on the island was located in this cave. The dropping ratio of Group A+B types 1 to 4 of obsidian

Table 5.20 Physical identification of surface and subsurface obsidian excavated from site R06-17.

R06-17		**Surface**	**0-15 cm**	**24 cm**	**0-110 cm**	**TOTAL**
Group	**Type**					
A	**1**	4	0	0	0	**4**
B	**2**	6	0	0	0	**6**
B	**3**	1	0	0	0	**1**
B	**4**	1	0	0	0	**1**
B	**5**	0	0	0	0	**0**
A	**1/1A**	0	0	0	0	**0**
A	**1A**	0	0	0	0	**0**
A	**1+2**	1	0	0	0	**1**
B	**2+3**	0	0	0	0	**0**
B	**3+4**	0	0	0	0	**0**
B	**3-3A**	1	0	0	0	**1**
B	**3A**	0	0	0	0	**0**
C	**-**	0	0	0	0	**0**
D	**Mayor**	3	1	1	0	**5**
No typology		3	1	0	4	**8**
TOTAL		**20**	**2**	**1**	**4**	**27**

found on the cave surface is consistent with that found on other surface sites. Although the small subsurface collection was not assessed to the Moore typology, the five 'grey' and two 'green' artefacts in it are visually consistent with this dominance of group A+B obsidian found elsewhere on this island.

R06-24: The excavation of the hearth site recovered 152 obsidian artefacts with the minority found on the surface (40) and the majority (112) occurring sub-surface. The largest number of artefacts were found in the top 10 cm of the site with decreasing numbers of artefacts recovered as the excavation deepened (Table 5.21; Figure 5.53).It is of note that the Mayor Island obsidian source is only represented by one example in this Hearth site. Table 5.17 shows the Hearth site follows the island ratio. The dropping ratio of Group A+ B type 1 to 4 of all 152 obsidian artefacts found here is consistent with that found on other surface sites. When broken down into the four depth categories of surface (39 artefacts), 0-10 cm (59 artefacts), 10-20 cm (34 artefacts) and 20-40 cm (21 artefacts), an assessment of each depth found the same broad dropping ratio (Table 5.21; Figure 5.53).

Table 5.21 Physical identification of surface and subsurface obsidian excavated from site R06-24.

R06-24		Surface	0-10 cm	10-20 cm	20-40 cm	TOTAL
Group	**Type**					
A	**1**	11	25	15	9	**60**
B	**2**	9	6	6	5	**26**
B	**3**	1	2	2	0	**5**
B	**4**	0	2	1	1	**4**
B	**5**	0	0	0	0	**0**
A	**1/1A**	0	0	0	0	**0**
A	**1A**	0	1	0	0	**1**
A	**1+2**	0	0	0	0	**0**
B	**2+3**	3	2	5	0	**10**
B	**3+4**	0	1	0	0	**1**
B	**3-3A**	0	0	2	0	**2**
B	**3A**	0	0	0	0	**20**
C	**-**	0	0	0	0	**0**
D	**Mayor**	0	1	0	0	**1**
No typology		16	19	3	4	**42**
TOTAL		**39**	**59**	**34**	**19**	**152**

<u>Obsidian tool types and the Moore typology</u>

The obsidian assemblage consists of 585 flakes (69%), 70 cores (8%) and 196 unidentified uncollected samples (23%) from the historic record (Table 5.22).This table shows that over the whole island, the ratio of flakes to cores is 8.4:1. When broken down into Moore typology groups A-D types 1-4, this ratio remains consistent in the range of 7-11:1. When groups A and B are examined on their own, the ratio variation is 8.6:1 and 7.3:1.

Table 5.22 Relationship of artefact types to the Moore typology

Moore Group	Flake	Core	Artefact Not Known	Ratio of known
A	248	29	93	8.6:1
B	196	27	64	7.3:1
C	3	1	0	3:1
D	8	1	0	8:1
No typology	130	12	39	10.8:1
TOTAL	**585**	**70**	**196**	**8.4:1**

Obsidian cortex and the Moore typology

In 2009 Moore noted that where cortex was present on the obsidian it was characterised as being generally rough to slightly water worn with only a few pieces having a smooth water-worn surface (Appendix 4i). With the subsequent completion of the GIS artefact data base it can be seen that 61% (523) of the complete assemblage (851) shows evidence of cortex. If the groups are divided into Moore's group typology and clustered as A+B and C+D, then the percentage of samples with cortex in A+B rises to 70% (443), while for C+D the percentage with cortex is only 8% (Table 5.23).

If only group A or B are examined, then the percentage of samples with cortex is 68% for A and 73% for B. If flakes and cores are looked at separately within groups A and B, then the percentage of flake samples with cortex is 60% for A and 74% for B, and the percentage of core samples with cortex is 93% for A and 83% for B (Table 5.23).

Analysis

The Moore typology of physical characteristics identifies three visually distinct sources of obsidian with unidentified Group A+B (98%), unidentified Group C (0.5%) and Group D (1.5%) identified as being Mayor Island source. Containing nearly all the assemblage Group A+B can be further divided into types 1-4 that form a descending presence ratio of 13:4:3:1. This descending ratio is found over the island as a whole, and is repeated in each of the eight site concentrations and in the grouped remainder of the isolates and scatters (Figure 5.52, 5.53 & 5.54). It is also repeated in each of the stratigraphic levels dug in site concentration R06-24 (Table 5.21; Figure 5.52). This suggests that Group A+B obsidian was deposited across the island in a single event and that this event occurred over a short time frame.

Looking at the overall records of all Groups of obsidian where the presence or absence of cortex was assessed, there is a qualitatively significant difference between the percentage of cortex remaining on Group A+B artefacts (70%) and Group C+D artefacts (8%). The high percentage of obsidian from Group A+B found with cortex suggests that raw material cobbles from sources A+B were directly procured from a nearby source (Moore, 2012b:29). The low amount of cortex found on the rare Group C+D obsidian therefore implies that this group must have been indirectly procured (Table 5.23).

Looking separately at Group A and B, the percentage of samples with cortex is 68% for A and 73% for B, which is not a significant difference. Comparing the 60-74% of cores with cortex to the 83-93% of flakes with cortex, this looks like a qualitatively significant difference. However it

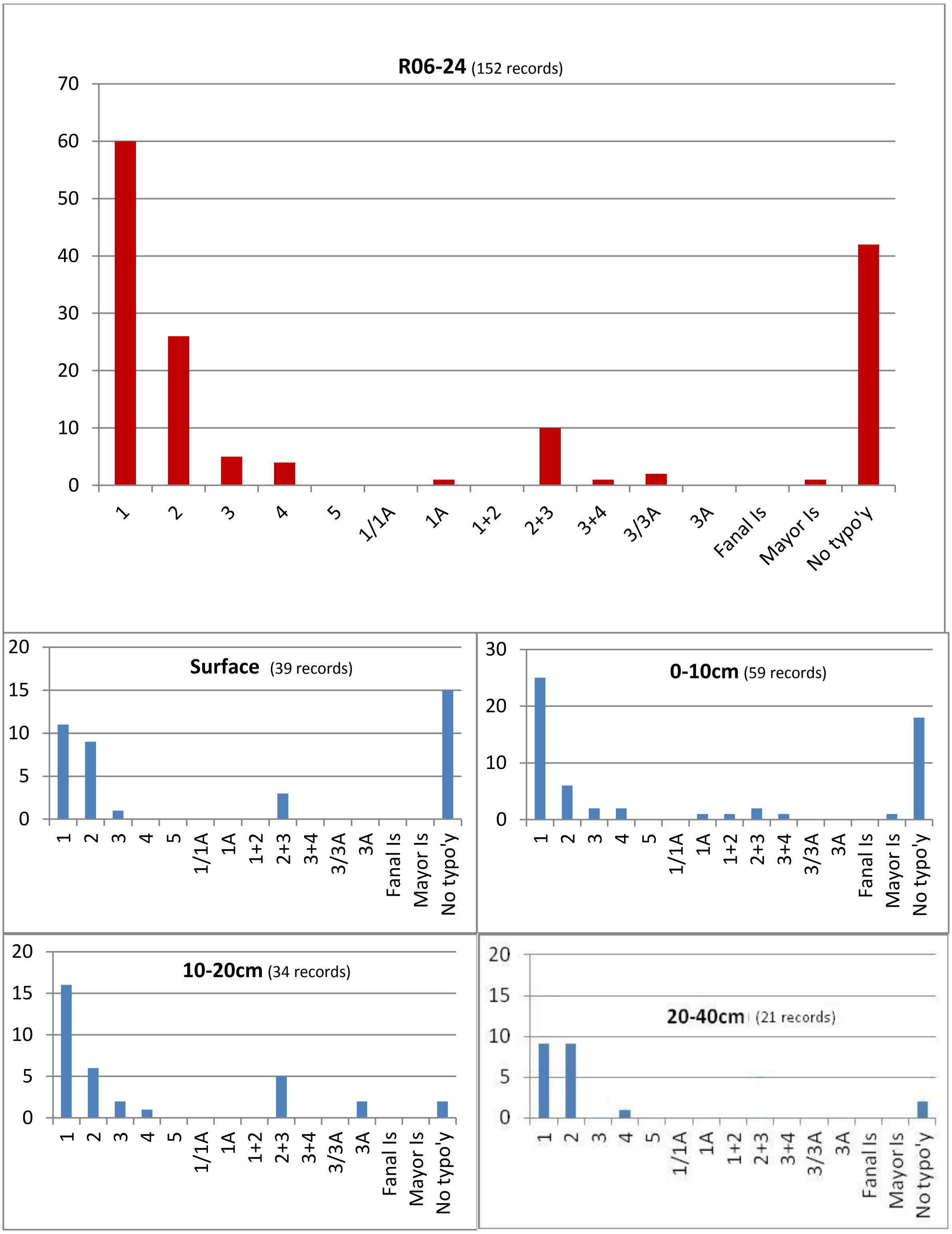


Figure 5.53 Typology of obsidian recovered from R06-24 in total (red). This is then broken down into four depth sub-categories. None show any significant change in the ratio of types 1-4.

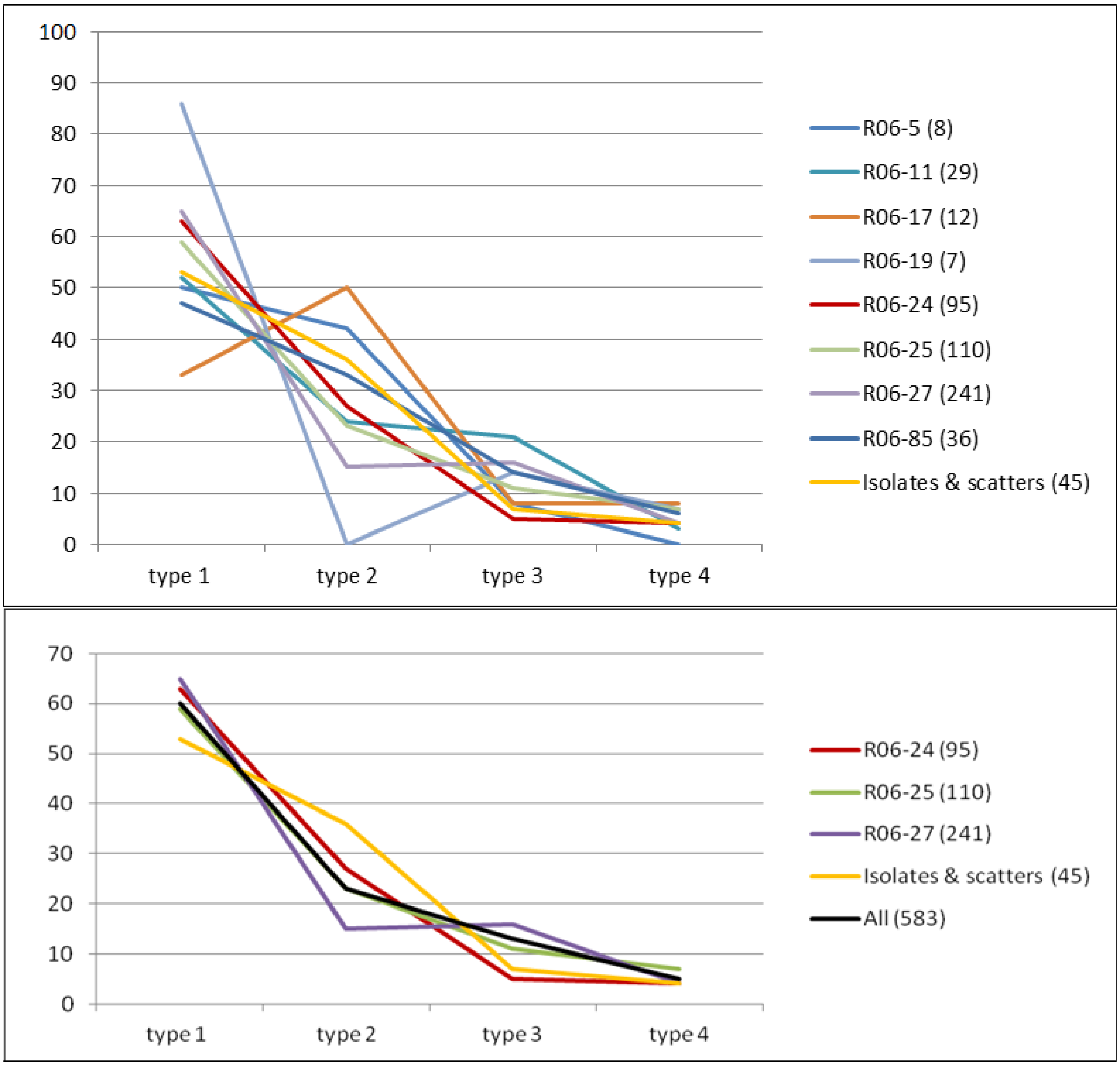


Figure 5.54 There is a close correlation of Moore typology Groups A+B types 1-4 descending ratios (i) with artefact locations with the most obsidian, and (ii) withisolates and scatters found over Tawhiti Rahi Island as a whole. Locations with less than 36 artefacts have larger variations due to small sample size (top). Locations with more than 95 artefacts (bottom) more closely match the overall island ratio.

is unclear how much of this difference is real or a product of the reduction processes involved in knapping flake tools.

Looking at the site specific records of Group A+B obsidian where the presence or absence of cortex was assessed; there is no significant difference between the isolates and scatters (74%) and the eight obsidian concentrations (67%). There is however a significant difference between the eight obsidian concentrations, with four (sites R06-5, 11, 19 & 27) showing 80-90% with cortex and four (sites R06-17, 24, 25 & 85) showing 50-60% with cortex (Table 5.17). Since the obsidian

Table 5.23 Relationship of the 851 artefacts to the Moore typology, artefact type & presence of cortex

More typology		Flake with cortex?				Core with cortex?				Unknown with cortex?				
Types	**Group**	**YES**	**NO**	**?**		**YES**	**NO**	**?**		**YES**	**NO**	**?**	**No.**	**TOTAL**
1	**A**	156	78	0		24	2	0		53	36	1	350	**370**
1/1A		1	0	0		0	0	0		0	0	0	1	
1A		4	0	0		2	0	0		2	1	0	9	
1+2		7	2	0		1	0	0		0	0	0	10	
2	**B**	64	25	0		9	3	0		20	11	0	132	**287**
2+3		26	3	0		2	4	0		8	3	0	46	
3		41	10	0		7	0	0		12	3	0	73	
3+4		0	0	0		0	0	0		0	1	0	1	
3/3A		1	2	0		1	0	0		0	0	0	4	
3A		1	1	0		1	0	0		0	0	0	3	
4		12	9	0		0	0	0		4	1	1	27	
5		1	0	0		0	0	0		0	0	0	1	
Not identified	**C**	0	3	0		0	1	0		0	0	0	4	**4**
Mayor is	**D**	1	7	0		0	1	0		0	0	0	9	**9**
No typology	**?**	48	9	73		8	2	2		6	18	15	181	**181**
Sub-total		363	149	73		55	13	2		105	74	17	851	
TOTAL		**585**				**70**				**196**				**851**

used is identical in all eight concentrations, this variation in the number of artefacts retainingcortex is unlikely to reflect direct and indirect procurement from an off island source. Rather it reflects functional differences in use once the obsidian has arrived on the island, with primary reduction occurring in the first group of four, and secondary reduction in the second.

Discussion

Obsidian is the dominant lithic material identified on Tawhiti Rahi Island. It arrived mostly as small water rolled boulders from colluvial deposits not found on the island. These have been worked to produce a generalist tool kit of cores, flakes and debitage that have been deposited on the island as isolates, scatters and concentrations.

A synthesis of the five points identified by the physical characteristics analysis identifies that a single source of obsidian (Group A+B) dominated the Tawhiti Rahi and (from the limited samples available) Aorangi assemblages. The repeating ratio of types within this source has a homogenous distribution both spatially and vertically. This dominant material was used in the production of simple flake tools from cores whose distribution and relationship with the presence of cortex is for the most part similarly homogeneous. Together these support the idea that the obsidian was deposited into the island archaeological landscapes in a single rapid event.

Moore (2012b) has shown that the longer a site is used the more reworking of obsidian occurs and the percentage of obsidian with cortex reduces. Poor Knights obsidian lacks any clear evidence of re-working, and since the presence of cortex at 70-80%is 10% higher than all but one of the 28 sites studied by Moore in Northland (Moore, 2012b: Table 5, pg. 29), this hints that the Poor Knights settlement associated with this obsidian was of only a short duration.

The key question to arise from Moore's typology is what is the originating source of Group A, B & C obsidian?Initially, Great Barrier Island was considered as a possible source in part because it is one of only five locations where red obsidian (Group B Type 5) has been found. Using comparative reference material at the University of Auckland, the limited samples available from the Great Barrier Island Te Ahumata obsidian source did find some similarities with Poor Knights obsidian Type 3, but they lacked glassy globules so were ruled out. The only other known source of Great Barrier obsidian is Awana, however this was also ruled out due to its marginal flaking quality (Cruickshank, 2011; Moore, 2009). From the physical characteristics alone, Moore tentatively suggested that Huruiki on the adjacent mainland was the most likely source of obsidian due to having similar characteristics to some Poor Knights Types (Types 1, 2 & 3) but not to others (Types 4 and 5).

The physical characteristics assessment suggests that obsidian groups A, B & C originate somewhere in the mid-north region of Northland that Moore identified as a separate area (Moore, 2013:49) that overlaps the northern parts of the Coromandel Volcanic Zone and the southern part of the Kerikeri volcanic group in Northland identified by Sheppard (Sheppard, 2011:46). However physical characteristics on their own cannot definitively confirm whether groups A, B and C originate from one of the known sources such as Whakapara or Huruiki on the mainland, or from offshore sources such as Te Ahumata, Awana or Fanal, or from an as yet unknown source. To answer this question we must turn to geochemical studies.

Geochemical analysis

Two complementary x-ray florescence (XRF) studies were used to attribute obsidian to a source location. First, a small scale high precision indicative study using both destructive and non-destructive XRF was completed. The goal of this study was to determine the source the Poor Knights Obsidian assemblage in a New Zealand context and to find out if the Moore typology based on physical characteristics was accurate. Second, a large scale representative study using non-destructive portable XRF (pXRF) was made. The goal of this study was to determine the range of natural variation in elements in this unknown source, and to develop a quantitative methodology using five trace elements to create a unique 'finger print' that might identify those New Zealand sources of obsidian most similar to our unknown source.

Small scale high precision study

To determine the source of the obsidian found in the Poor Knights assemblage a representative sample was sent in 2009 to the University of Auckland for geochemical analysis using both destructive and non-destructive XRF analysis. First, a total of twenty three pieces were analysed by non-destructive energy-dispersive XRF (EDXRF) using the portable Innov-X spectrometer at the Anthropology Department, University of Auckland. The pieces were selected from all four groups – 5 from Group A (Type 1), 13 from Group B (6 of Type 2, 3 of Types 3/3A, 3 of Type 4, 1 of Type 5), 3 from Group C and 1 from Group D. Several reference samples from potential sources Te Ahumata, Awana, Fanal Island and Huruiki were also analysed. All samples were run for 6 minutes, and the data were automatically downloaded onto an iPAQ PDA computer. For quality control, an internationally accepted obsidian standard (NIST 2709) was run at the start of each session and again after each 8-10 samples. Using the known parts per million (ppm) for the NIST 2709 standard, the net energy results were then converted to ppm. This methodology provides a ppm 'ratio' level of measurement that has (i) inherent ranking, (ii) fixed distance between categories and (iii) a meaningful zero point. As such, this is the highest level of measurement available, and results were used as a baseline for data against which the larger scale representative XRF study, that uses a lower 'interval' level of measurement, was compared.

The Innov-X spectrometer machine routinely measures the concentrations of 25 elements but does not include the lighter elements of silicon (Si), aluminium (Al), sodium (Na) and magnesium (Mg). Detection limits for most elements are 10-100 ppm, with 250-2500 ppm for potassium (K) and calcium (Ca), and precision errors are typically <5%. However measurements of some elements have considerably larger errors, and hence they have been excluded from consideration, along with those below instrument detection limits. The elements of greatest value in sourcing obsidian are rubidium (Rb), strontium (Sr) and zirconium (Zr), which have errors of only about 1-3%. Zinc (Zn) may also be useful in some cases. Table 5.24 shows the ppm analysis results for these four elements only.

Table 5.24 EDXRF analyses of Poor Knights artefacts (all concentrations in ppm)*

Bag No.	**Group**	**Type**	**Zn**	**Rb**	**Sr**	**Zr**
2	A	1	34	200	39	239
3	B	2	33	192	34	240
10/5	C		24	194	43	144
22	A	1	35	190	36	239
24	B	3/3A	34	199	38	242
26	B	2	31	190	38	240
44a	B	2	43	213	40	269
65a/2	A	1+2	31	192	36	234
68/2	C		27	199	45	148
70	A	1	35	194	36	254
73b	B	2	34	194	34	265
74	B	3	32	193	35	252
84a	B	4	32	181	34	230
100	B	3	36	201	38	247
112	B	2	29	184	36	233
115/2	C		24	194	44	147
120	D		205	154	4	1158
122/2	A	1A?	37	194	36	243
328/1/4	A	1	37	195	36	241
328/1/5	B	2	38	188	37	237
328/1/6	B	3	31	190	34	238
328/1/7	B	4	31	187	36	236
94	B	5	32	192	37	245

* Table 1 from Appendix 4(i). Analyses by J. Wilmshurst, University of Auckland

Five samples were also analysed by conventional wavelength-dispersive XRF (dXRF), which is a destructive process, using the Siemens SRS 3000 sequential X-ray spectrometer at the Geology Department, University of Auckland. The same samples had previously been analysed by EDXRF, and represented groups A, B and C. Analysis was by the low dilution fusion method, which involved the preparation of beads of powdered sample mixed with a lanthanum oxide flux in a ratio of 2g of ignited sample to 6g of flux. Sample size ranged from 8 to 14g in weight, and only two of the pieces were completely destroyed. The results from both destructive and non-destructive studies with a sourcing interpretation are in Moore's draft document (Appendix 4i). The results of the dXRF are summarised in Table 5.25.

Table 5.25 University of Auckland dXRF analyses of Poor Knights artefacts (anhydrous)* Elements highlighted in bold are the five elements used for sourcing in this study.

Sample Bag No.	**PK70**	**PK3**	**PK74**	**PK328/1/7**	**PK10(5)**
Weight (%)	**Type 1 (group A)**	**Type 2 (group B)**	**Type 3 (group B)**	**Type 4 (group B)**	**Group C**
SiO2	73.86	73.78	72.46	72.95	75.68
TiO2	0.21	0.21	0.21	0.21	0.18
Al2O3	13.53	13.58	13.28	13.37	12.74
Fe2O3	1.76	1.76	1.76	1.75	1.36
MnO	0.03	0.03	0.03	0.03	0.02
MgO	0.22	0.23	0.23	0.22	0.24
CaO	0.83	0.84	0.83	0.83	0.92
Na2O	4.36	4.37	4.28	4.3	3.74
K2O	4.66	4.64	4.62	4.65	4.47
P2O5	0.03	0.03	0.03	0.03	0.04
H2O*	0.08	0.07	0.09	0.11	0.09
LOI*	0.26	0.38	0.36	0.42	0.26
Total*	99.61	99.58	97.85	98.47	99.49
Trace Elements(ppm)					
Sc	5	3	6	3	4
V	10	11	11	11	18
Cr	3	3	3	2	4
Ni	0	0	0	0	0
Cu	0	0	0	0	0
Zn	**39**	**41**	**41**	**40**	**31**
Rb	**202**	**202**	**199**	**200**	**209**
Sr	**34**	**34**	**35**	**35**	**47**
Y	43	43	42	43	32
Zr	**255**	**258**	**254**	**253**	**156**
Nb	**11**	**12**	**11**	**12**	**10**
Ba	400	403	409	400	312
Pb	23	23	23	25	23

* Table 2 from Appendix 4(i). Analyses by J. Wilmshurst, University of Auckland

Results

The EDXRF analysis shows that Rb, Sr and Zr values for artefacts in groups A and B (Types 1-5) are very consistent, and clearly indicates that the obsidian in these two groups came from the same source (Table 5.24). The Sr and Zr values for Group C are on the other hand quite different, and confirm suspicions from the physical characteristics that the pieces in this group are from a different source. Zinc values are also slightly lower. The composition of the one analysed piece of Group D obsidian differs markedly from that of the other three groups, confirming that it originated from Mayor Island.

The results of the dXRF analyses shown in Table 5.25 confirm the results obtained by EDXRF in demonstrating that Types 1-4 in Groups A and B have the same composition, with remarkably similar values for Rb, Sr, Y, Zr and Ba, and also most major elements. In contrast, the sample of Group C obsidian has a very different chemistry with significantly lower concentrations of Fe, Na, K, Y, Zr and Ba, and higher Si and Sr values. The Rb value, however, is almost identical to that of Types 1-4.

Discussion

The EDXRF and dXRF analyses confirm that we are dealing with three obsidian sources made up of Group A+B, Group C and Group D. To determine an actual source location, these results were compared with results from material obtained as part of a separate project from the potential sources at Te Ahumata, Awana, Fanal Island and Huruiki. The three key elements of Rb, Sr and Zr are presented in two binomial plots that show Rb v Sr and Zr v Rb (Figs 5.55& 5.56). It is evident from the Rb versus Sr plot (Figure. 5.55) that the Type 1-5 artefacts found in Groups A+B form a separate cluster situated between the Fanal Island, Te Ahumata and Awana sources. Furthermore, the group A+B artefacts plot in a slightly different position from the Group C obsidian, which is closer to the Fanal Island field. From this it is clear that the Poor Knights obsidian assemblage certainly did not come from the Huruiki source.

A much clearer separation of groups A+B and C is evident on the Zr-Rb plot (Fig. 5.56), which emphasizes the significantly lower Zr values of the latter group. It is notable that the one piece of red obsidian (Type 5) plots in the middle of the group A+B cluster and cannot therefore be from Taupo, Waihi, Otoroa or Mayor Island sources. The Zr-Rb plot also clearly demonstrates that none of the five types founding Group A+B obsidian came from the Te Ahumata source and almost certainly not from the Awana source either. The Group C samples, however, plot within or adjacent to the Fanal Island field, and therefore it is reasonable to conclude that they originated from that source.

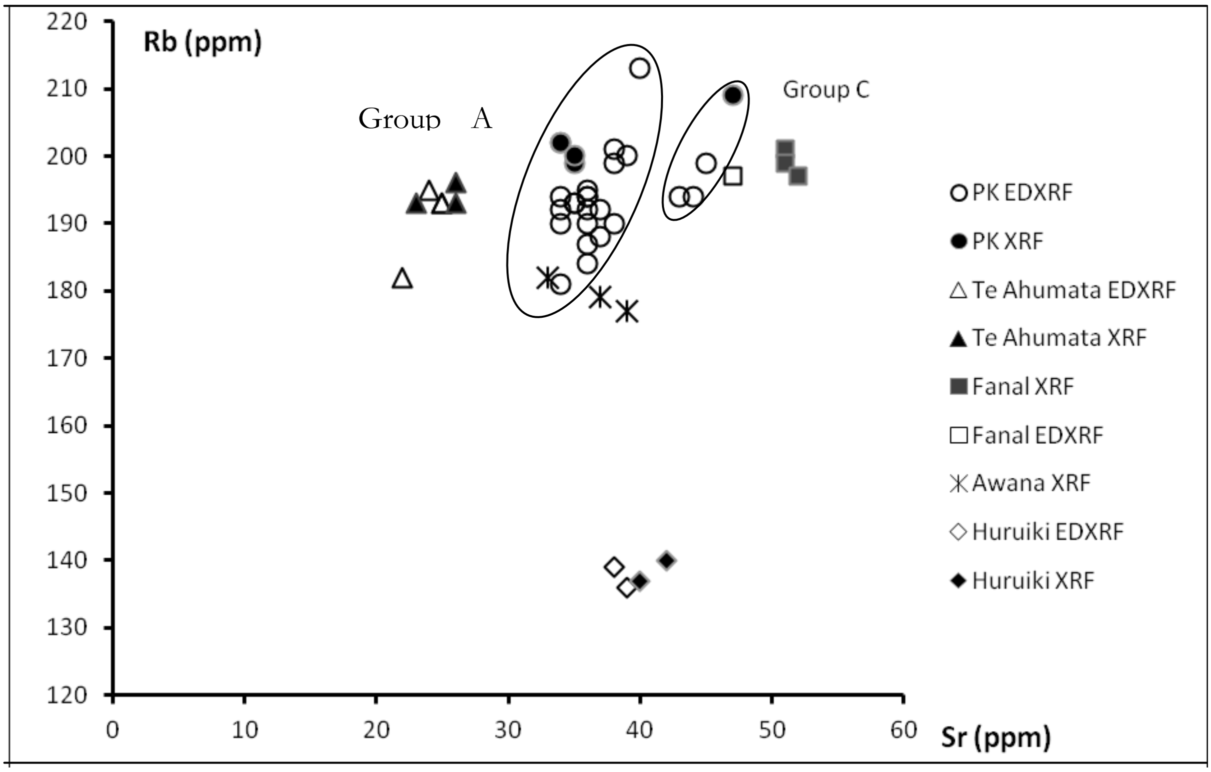


Figure 5.55 Plot of Rb versus Sr for Poor Knights artefacts and potential sources (Mayor Island is not shown).Ovals show 95% data confirmation for identified groups.

[Figure 0 from Appendix 4(i). Analyses by J. Wilmshurst, University of Auckland]

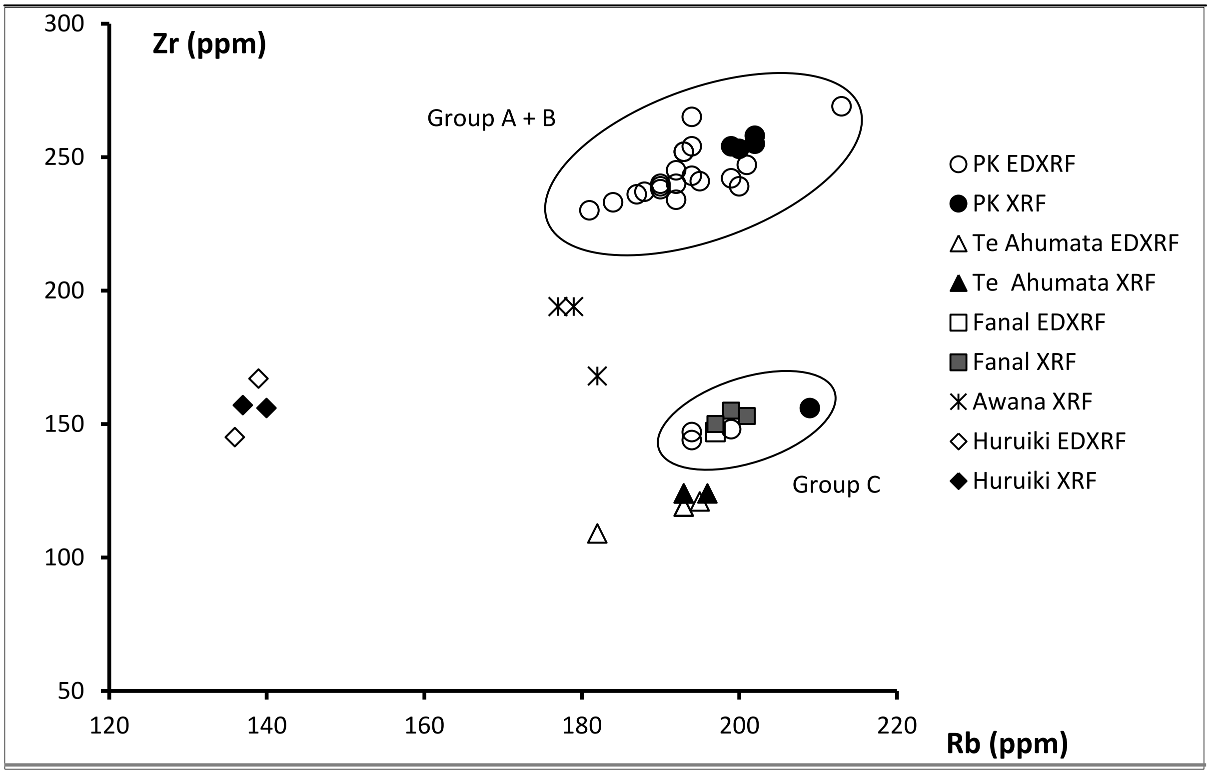


Figure 5.56 Plot of Zr versus Rb for Poor Knights artefacts and potential sources (Mayor Is not shown). Ovals show 95% data confirmation for identified groups.

[Figure 00 from Appendix 4(i). Analyses by J. Wilmshurst, University of Auckland]

If Group D obsidian artefacts are sourced to Mayor Island and Group C obsidian artefacts are sourced to Fanal Island in the Mokohinau Islands, the key question then is where do Group A+B obsidian that dominates the Poor Knights assemblage source to? The possibility that the obsidian occurs naturally on the Poor Knights as some sort of 'lag' deposit can be ruled out for two reasons: First, because the available analyses of the island's rhyolite indicates that they have very different Sr, Rb, Zn and Zr values (Nicholson, 1996 APP AI, AII and CIII). Secondly, because the Poor Knights lack any high energy stream or coastal platform environments that could have produced the slightly water worn cortex present on the majority of obsidian studied. Compared to any other source in New Zealand, Group A+B obsidian are most similar to the Fanal, Te Ahumata and Awana sources - a separate sub-region at the northern end of the Coromandel Volcanic Zone (CVZ) that Moore identified as the 'Great Barrier Group' (Moore, 2013:49). However Group A+B remains different enough from the Great Barrier Group to rule them out as source locations. Instead Moore argues that group A+B obsidian came from an as yet unknown source, and that this source is most likely to be found somewhere within the Great Barrier sub-region, most probably on Great Barrier Island, although eastern Northland cannot be entirely excluded (Appendix 4i). This sub-area that incorporates the southern part of the Northland volcanic region and the Great Barrier Group will now be referred to as the mid-northgroup.

This small scale study has confirmed that the Poor Knights obsidian assemblage is dominated by a single unknown source of culturally utilised obsidian (Group A+B) located somewhere within the volcanic sub-region called the mid-north group. Considering the similarities in chemical composition found between the mainland sources of Whakapara and Huruiki and the offshore Island sources of Te Ahumata, Awana and Fanal a comprehensive large scale XRF study is needed to determine whether this unknown source can be distinguished from its near neighbours and where it is most likely to be found.

<u>Large scale representative study</u>

A large scale representative study was made using non-destructive XRF. This looked for sourcing patterns within the middle part of the mid-north volcanic region. Specific questions addressed were;

1. What is the range of natural variation in elements in this unknown source?
2. Can a quantitative methodology be developed that would identify the distinctive five trace element 'fingerprint' of 16 known New Zealand obsidian sources and if so, can it be used to identify the known obsidian sources within this mid-north group?

Method

A University of Otago portable Bruker pXRF instrument was used for a large scale representative analysis of Poor Knights obsidian. Previous studies have shown that while Bruker pXRF machines have some inter-instrument variation in accuracy, they have intra-instrument consistency in precision (Nazaroff et al, 2010:894). This means the Bruker pXRF machine used for this study can effectively distinguish between the sources of closely related obsidian.

This machine was equipped with a rhodium tube X-ray source and a peltier cooled, silicon PIN detector, operated at 40 kV and 2.5 4μA. An external power source was applied for 300 live seconds using the 'Green' filter composed of 6 mil copper (Cu), 1 mil titanium (Ti) and 12 mil Aluminium (Al). The obsidian samples were positioned with as much contact as possible to the instruments surface so as to maximize the X-rays hitting the object. This optimises the count rate and mitigates the effects of non-level surface structures on the X-ray scatter. Energy counts were processed using the Bruker SIPXRF spectra program, and net energy counts were taken. Due to the NIST 2709 obsidian standard not having yet arrived in the department, no direct instrument calibration could be made with a single standard of known chemistry. Unlike the Auckland data, ppm could not be made, and only net data was produced. Net data results have inherent ranking and a fixed distance between categories, but lack a meaningful zero point. This gave an 'interval' level of statistical measurement, a step below the 'ratio' level of statistical measurement used in the Auckland XRF study. In practice, the lack of ppm data means we can only compare samples run through this machine on the same settings. To determine where an obsidian sample is sourced from, we needed to run both the Poor Knights obsidian and obsidian from the University of Otago Anthropology Department New Zealand wide comparative lithic collection, and then compare results.

Comparisons with the previous small scale high precision study can be made because this large scale representative study of Poor Knights obsidian re-analysed all the surviving material previously analysed through the University of Auckland portable Innov-X spectrometer pXRF machine. Since both analyses show similar clustering, the floating Otago net data can be visually compared to the fixed Auckland ppm data which does have a meaningful datum or zero created by the use of the NIST2709 standard.

The methodology of how to process the data was chosen after discussions with statistician Dr Peter Dillingham from the University of Otago Mathematics and Statistics Departments. Considering that XRF data is essentially a one-to-one relationship between energy in and energy out, and that there were a number of unknown potential variables in my data (including accuracy and precision factors), it was preferable to use raw net energy data rather than to potentially further confuse the issue by applying cluster analysis to one or two elements. Instead we utilised five elements in tables and line graphs. The thinking behind this approach was that every source of obsidian in New Zealand has a pattern of net energy for the five key trace elements of Rb, Sr, Y, Zr and Nb. In broad terms each of the four primary clusters of New Zealand's obsidian - identified here as the Northland Volcanic Region (NVR), Coromandel Volcanic Zone (CVZ), Taupo Region and Mayor Island (Shepherd, 2011) - will contain obsidian that is internally similar and externally different. Sources within each cluster will be more closely related to each other having similar trace elements over 3 or even 4 of the 5 elements. It is only when all 5 elements are seen in a table or as a line graph ratio that the importance of the relative values for sourcing within a cluster will become apparent.

Net data from the Bruker machine was generated from 110 samples from the Poor Knights obsidian assemblage and from 21 samples from 16 known sources that cover the four primary volcanic regions in New Zealand currently held in the department's comparative collection. The data was then compared using a modified Kahurangi Table developed by the author to source an obsidian sample excavated from the Kahurangi site in Southland New Zealand. Using this excel table, the net energy of five trace elements (Rb, Sr, Y, Zr and Nb) was compared between known and unknown sources. Specifically, the Kahurangi table measures the percentage difference of these elements between the samples from these 16 known sources and the unknown samples from the Poor Knights Islands. All percentage differences were converted to positive figures and then added together to produce a distance measure. The smaller the resulting distance measure number the more similar that known source is to the unknown sample.

The modifications to the original Kahurangi table revolve around creating two levels of exclusion criteria that should remove dissimilar sources. These are:

1. Using Rb, Sr, Y, Zr and Nb - a known source is excluded when any single trace element value is >60% different from the unknown source.
2. Using only Rb, Sr, and Zr - a known source is excluded when any single trace element value is >60% different from the unknown source.

Following application of these exclusion criteria, samples were only examined further if the measured percentage difference for five elements is less than 100%. The four smallest distance measure results less than 100% were then plotted using a five element line graph, and then overlaid on a five element line graph of the unknown obsidian. This final step is a qualitative assessment that looks for how much the unknown sample 'mirrors' the known samples and, if close enough, the closest match is considered to be the source.

Results

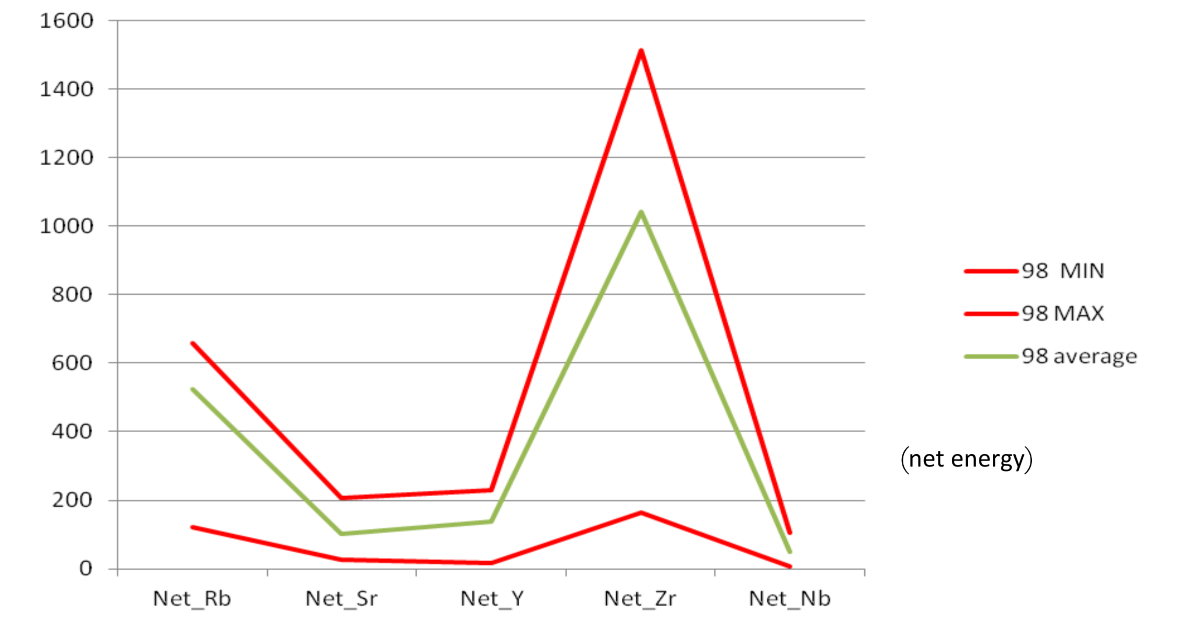
Analysis of this much larger number of Poor Knights obsidian samples (110) identified a total of five groups of obsidian (Appendix 4ii, Tables A-F). When compared to results from the comparative collection, four of the five groups are shown to originate in the mid-north region (Fanal, Huruiki, Awana and unknown source) and only one – Mayor Island – from another volcanic zone (Table 5.26).This is defined in more detail below.

The first question of this analysis was to determine the variation or natural range of elements found in typology Group A+B. Here a total of 205 separate XRF readings (net energy – not ppm) were made of 98 obsidian samples which required every sample to be processed through the instrument at least twice. The two charts in Figure 5.57 below show the results. The top chart consists of the 205separate XRF readings including anomalous outliers. The bottom chart takes a 95% sample comprising 193 XRF readings of 96 samples where all outliers are removed. The removal of only 12 outlier readings and only two complete samples dramatically tightens up the results and shows that group A+B has a consistent minimum/maximum range. Using the two largest elements of Rb and Zr this range averages 28-30%.

The second question of the research was to develop a quantitative methodology using XRF results for sourcing obsidian to one of New Zealand's four volcanic regions. To this end the modified Kahurangi table was created to provide a comparison between the distinctive pattern of five trace elements between 110 unidentified Poor Knights samples and 16 known sources from the department's comparative collection. When entered into the table, the results clustered into five groups. Three of these mirrored the physical characteristics of Groups A+B, C and D identified by Moore in the typology, while three samples were allocated to two new groups called 'unidentified 1'(2 samples) and 'unidentified 2' (1 sample). The results are set out in the appendices' (Appendix 4ii, Tables A-F) and clearly show that Group D is from the Mayor Island volcanic region through the use of exclusion and non-exclusion criteria. This is to be expected since Mayor Island's Zr values range from 3800-4200 (net), and no other source in New Zealand has similar or overlapping Zr values. In effect, the Zr element can be used on its own here as a 'silver bullet' to confidently source Mayor Island obsidian. All the remaining obsidian from the Poor Knight assemblage (obsidian Group A+B, Group C, unidentified 1 and unidentified 2) did not sit clearly within a single volcanic zone, but rather clustered around the boundary of the Coromandel Volcanic Zone and the Northland Volcanic Region. Similarities between the Huruiki

Table 5.26 University of Otago XRF analyses of Poor Knights obsidian artefacts.

Sample groups	**A+B**	**C**	**D**	**Unidentified 1**	**Unidentified 2**
	Unknown source	Fanal Island	Mayor Island	Huruiki	Awana
No. of artefacts	98 (89%)	3 (2.7%)	6 (5.4%)	2 (1.81%)	1(0.9%)



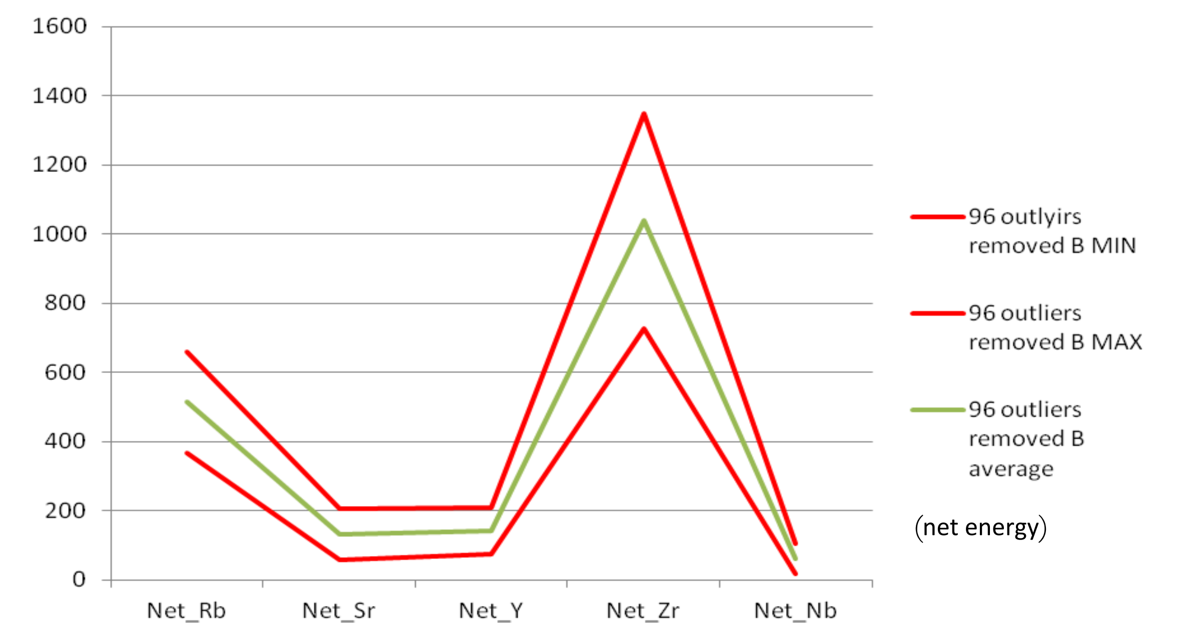


Figure 5.57 pXRF analysis: Minimum and maximum trace element range for Tawhiti Rahi Group A+B unknown obsidian source, using net energy only. Top graph shows the broad min/max variations that result when all 205 readings from 98 samples are used. Bottom graph shows the tight min/max variations resulting from 193 readings from 96 samples and 193 reading when outliers are removed. This is 95% of the total sample.

and Whakapara sources on the Whangārei coast and the Fanal, Awana and Te Ahumata sources on islands offshore from the Whangārei coast suggest that the Moore 'Great Barrier' group (Moore, 2013) should be extended to include these mainland sources which is part of the previously defined 'mid-north group'.

As shown in Appendix 4ii, Table A, the measured percentage difference for Group A+B using the first exclusion criteria would suggest there is not a strong match with a known source. Applying the second exclusion criteria identifies only one source with less than an 80% similarity (Awana) and four sources in the mid-north region in the 80-95% range. This suggests Group A+B is a related but as yet unidentified source of obsidian in the mid-north region of New Zealand. The fact that the least different sources are Awana and Te Ahumata gives a degree of support that this unknown source is located on Great Barrier Island; however this cannot be confirmed from this data. It may be significant that the qualitative visual graph comparison shows that the Awana source best mirrors the unidentified material of Group A+B apart from having a too low a Zr value. What is important about this unknown Group A+B source of obsidian is that like the Mayor Island material, it too has a distinctive Zr peak different from all other obsidian. As such it too can also be a 'silver bullet'. By this I mean the Zr values donot overlap with Zr values from any other known sources Zr range and therefore identification can be made using only this one element. This lack of overlap is clearly visible in the binomial plot Zr v Nb for both the small scale high precision study using ppm (Figure 5.56) and the large scale representative study using net energy (Figure 5.58).

Section discussion

The purpose of the XRF analyses was to source the obsidian found on the Poor Knights Islands. The results of the Otago XRF analysis strongly support the Auckland XRF results in sourcing Group D obsidian artefacts to Mayor Island and Group C obsidian artefacts to Fanal Island in the Mokohinau Islands. The 'Unidentified 1' and 'Unidentified 2' material were only analysed at Otago and the results give moderate support to the sources being Huruiki and Awana respectively. Group A+B obsidian clearly originates in the mid-north volcanic group located between Great Barrier Island and the Northland mainland in the Whangārei district. Sourcing Group A+B within this group however remains problematic.

The key result from this geochemical analysis is that this unknown obsidian source has a distinctive Zr element value that has only minor variation and sits at 800-1200 (net) energy [220-270 (ppm)] where it borders the Huruiki, Great Barrier Island and Mokohinau sources. When compared, significant differences in the element record suggest that Group A+B obsidian does

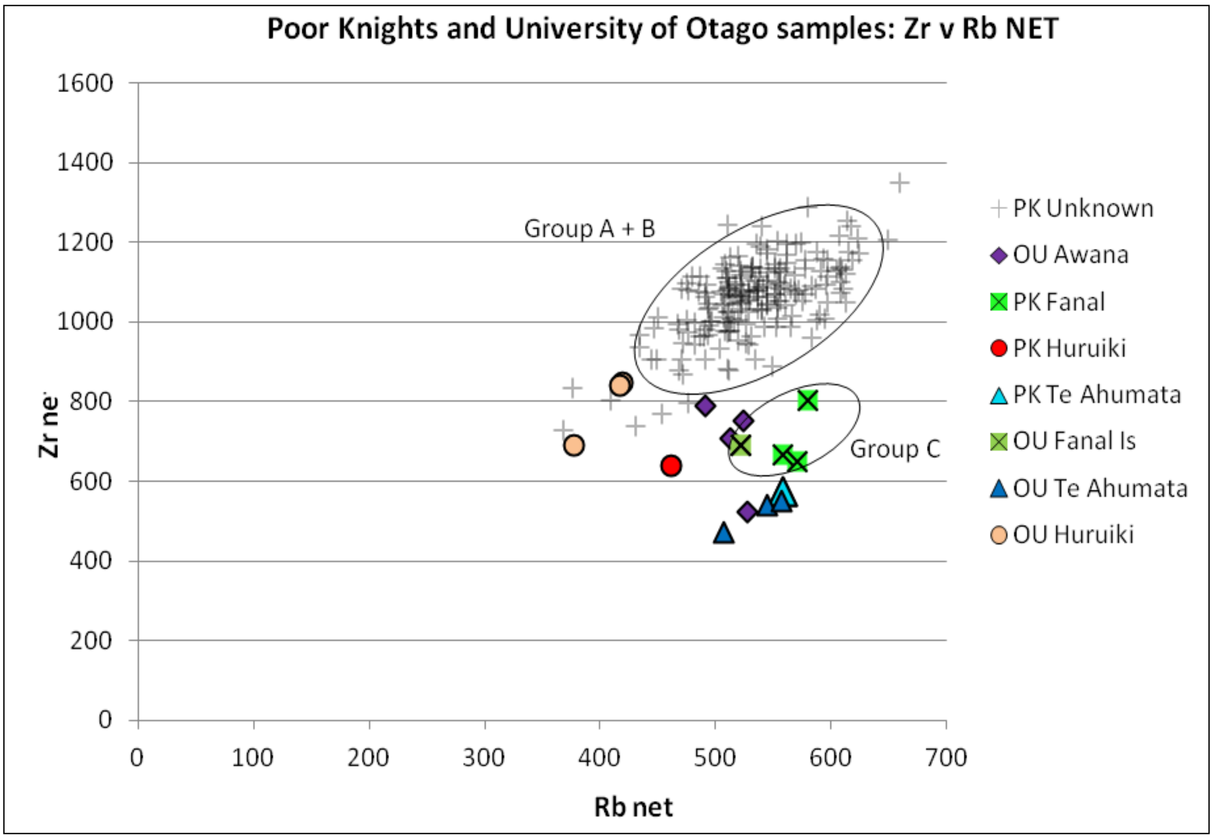


Figure 5.58 pXRF analysis: Plot of Zr versus Rb trace elements for Poor Knights obsidian, andfor otherpotential sources in New Zealand (Mayor Island obsidianis not shown). Ovals show 95% data confirmation for identified groups.

not originatefrom any of the Huruiki, Fanal, Te Ahumata and Awana sources; however certain similarities appear with Awana source variants Windy Canyon, Awana Falls and Peach Tree Track. These three mirror the Rb, Sr, Y and Nb values and have the closest Zr value with a range of 180-225 ppm (Cruikshank, 2011 Appendix B and Figure 7-4). This suggests that a colluvial area on the western side of Mt Hobsonon Great Barrier Island may be a good place to prospect for the source of the Group A+B obsidian artefacts found so extensively on the Poor Knights Islands.

It is acknowledged that the results produced in this University of Otago XRF research only provide 'interval' levels of measurement and that this is open to further review and that the samples will need to be rerun with a NISP 2709 standard before any publication could occur. However the consistent pattern of results obtained and the clear correlation with the ppm data obtained by the University of Auckland XRF analysis suggest that this methodology shows some potential especially as an initial field test that should broadly sort obsidian to source. After field testing, a representative sample could then be sent to specialist obsidian laboratories for independent confirmation and PPM conversion.

Obsidian conclusion

The extensive modification of the island by ground burrowing Buller Shearwaters has caused extensive bio-turbation of archaeological sites as well as disruption of area with no archaeological features. This process involves digging of new burrows as well as the periodic deepening and cleaning out of old ones, and results in any buried obsidian being re-deposited up onto the surface as well as moving obsidian both up and down in the topsoil (This is supported by evidence from the Hearth excavation Chapter 5 Section II). If any buried Mayor Island obsidian deposits were present somewhere on the island, this bio-turbation should have brought them to the surface by now. Therefore the rarity of Mayor Island obsidian in the island's obsidian assemblage reflects the reality that it is not present here in any significant amounts. Various authors have discussed the prevalence of Mayor Island obsidian in early sites all around New Zealand, and its later reduction in range and number as regional sources of obsidian developed later in prehistory (B. Leach & De Sousa, 1979; Davidson, 1981; Seelenfreund-Hirsh, 1985; Cruikshank, 2011; Walter et al & Jacombe, 2012). Specifically, direct access to Mayor Island obsidian becomes constricted over time and there was a significant decline in its use after 1500AD probably due to the development of more complex obsidian distribution networks using multiple sources (Moore, 2012b:31). It is generally accepted that Mayor Island obsidian was the most commonly used source of obsidian in the first few hundred years of Māori settlement (Seelenfreund-Hirsh, 1985:247), but attempts to use the presence of Mayor Island obsidian to prove early settlement have not been successful (Davidson, 1981: 114). However the near absence of Mayor Island obsidian (<1%) and the dominant presence of a single mid-north obsidian source (>98%) in the Poor Knights assemblage implies that settlement here did not occur early in prehistory.

In New Zealand obsidian had both profane and sacred functions (Shawcross, 1976). Since both practices require the same sort of flake cutting tools and result in the same sort of edge ware damage, it is only in the context of where they are found that provides the functional clue. The significant quantities of culturally deposited obsidian noted and sampled on the Poor Knights Islands are for the most part associated with food and other 'noa' (profane) practices. However some of the obsidian material in the cave site R06-17 may be associated with the conceptual boundary of water rolled boulders and with the historically reported evidence of tufts of cut hair seen their and so may be 'tapu' (sacred) (Wilson, 1959). Actual hair cutting tools and collections of hair were photographed from a cave on the adjacent Aorangi Island (Fraser, 1925).

Analysis of the spatial distribution of obsidian found here in both widely distributed surface scatters and in narrow concentrations provides a remarkably homogeneous picture, with the ratio of Moore's A-D morphs found in all sites being statistically indistinguishable from each other. The fact that the stratigraphic distribution of these morphs as analysed at the Hearth (R06-24) and Cave (R06-17) excavation sites is similarly homogenous suggests that this assemblage is likely to be only a single deposit, and probably brought to the island in a short time frame.

In regard to the XRF analyses, both the small sample high precision study representative of Moore's obsidian typology and conducted at the University of Auckland and the larger scale representative study of Moore's typology carried out by the author at the University of Otago, determined that apart from isolated examples sourced to Huruiki and Awana, three samples from Fanal Island and nine samples from Mayor Island, the remaining 98% of the obsidian in the Poor Knights assemblage came from one as yet unknown source located somewhere in mid-northern volcanic sub-region of Northland – most likely somewhere on Great Barrier Island. It is argued here that the lack of significant quantities of Mayor Island obsidian and the presence of a dominant Great Barrier source is inconsistent with an early settlement of the island. Rather it suggests that the Māori settlement reflected in the villages, specialist sites and ceremonial sites visible on the ground today utilised a local hub of obsidian supply and as such must have occurred late in prehistory.

5.3.1.2 Non-Obsidian Lithics

The lithic portable material culture encountered on the Poor Knights includes locally sourced white rhyolitic volcanic tuff (Chapter 4) along with imported material that includes obsidian, chert, dolerite, basalt, gabbro and ochre. The types of tools made from these lithics and their association with certain site types can inform us about site function, so engaging with the 'why' question. Determining the source of these lithics can provide links to other locations and indirectly to related communities, thus engaging with the 'who' question. Finally, if the distinctive type of adzes recorded on this island can be broadly dated to a specific period in New Zealand's prehistory, this will give some insight into the 'when' question.

The analysis will begin with a general discussion about local and imported rhyolitic rock and the uses it was put tofollowed by a discussion of the other lithic material under specific tool headings

- Flakes: [imported chert]
- Adzes: [imported Dolerite and gabbro]
- Water rolled boulders: [imported basalt]
- Hammer-stones: [imported siliceous rhyolite]
- Miscellaneous tools: [imported sandstone]
- Ochre: [imported or locally produced]

Rhyolitic Rock

The rhyolitic volcanic eruption that formed the Poor Knights originally left the ground surface of Tawhiti Rahi Island covered with a layer of small loose tephra amongst larger boulders and natural outcrops. Except for two remnant areas of unmodified ground at the northern end of the island today [Feature OBJID2088 & 2447], nearly all of this loose material has been removed by Māori. The rock was used to create a range of cleared areas and stone structures associated with Māori gardening and habitation. All variants of the local tuff (see Chapter 4 Geology section) have been used as a construction material to build the archaeological landscape described in Chapter 5 Section I. Specifically, the rock has been extensively used to face the earth terraces as well as forming the bulk of the stone mounds, rows and alignments. The area where rock has been removed is even more significant in that these are locations where ethnographic sources indicate gardening occurred in prehistory.

This loose rhyolitic rock varies from banded ash through breccia, rhyolitic tuff to silicified tuff depending on whether the rock was formed from cooler ash fall or hotter pyroclastic flows and to the degree of silicification that occurred post deposition (Chapter 4; Appendix 5:i). In addition to being used in construction, this rock is also found in a portable material culture context within archaeological sites. The archaeological subset of these forms is set out in the following table and shows that all eight variants of the parent rock have been used, but that sinter (20), rhyolitic tuff (55) and silicified tuff (74) were the most common material recovered (Table 5.27).

A total of 198 samples of rhyolitic tephra have been recorded from surface collections and excavations (Table 5.28). All are associated in one way or another with confirmed archaeological sites, 53 (27%) show modification such as burning or reduction processes (such as hammer stones, cores, flakes, blades and scrappers)that can be directly associated with human action. The location patterns of these known artefacts can inform about site use. An example of this are fire cracked rock produced by cooking fires or ovens being found on habitation terraces in 14 places throughout the island, but only one of these was associated with a lithic work floor (R06-27). In contrast, all but two of the 32 water rolled pebble hammer stones made from basalt, jasper, quartz, sinter and rhyolitic tuff are found at the southern end of the island south of the plateau escarpment (see more detailed discussion below).

Discussion

A study by Dr M Turner confirmed that the local rhyolite had moderate to good coinchoidal fracture characteristics and was strong enough to be made into flake tools (Appendix 5:ii). When compared to the extensive cultural deposits of imported obsidian, it is surprising then that only

Table 5.27 Rhyolitic type rock found in cultural contexts on Tawhiti Rahi Island.

R06-sites		5	8	11	90	91	12	14	85	13	89	20	24	25	29	27	28	17	19
Geographic Areas		**North Penin'la**	**North Stream Valley East**	**Central ridge N&NW Stream valley**			**Central Ridge&West cliff**				**South Plateau Escarpm't**	**South Stream Valley Lowlands**						**SE Cliff**	
TYPES	**No.**																		
Banded volcanic ash	3												3						
Breccia	9												8						1
Quartz	1												1						
Rhyolitic tuff	55			1			1		1				25			3		4	
Silicified rhyolitic tuff	7		1	1	1				4				6					3	1
Silicified tuff	74	8		6	3	1	2	2	3	2	5	1	29	25		8			
Silicified ash	1													1					
Sinter	20												10	3	1	6			
Unknown	19	1		3	1			4	6					1		1	2		
TOTAL	198	9	1	11	5	1	3	6	14	2	5	1	82	30	1	18	2	7	2

Table 5.28 Portable material culture made from rhyolitic rock found on Tawhiti Rahi Island.

R06-sites		5	8	11	90	91	12	14	85	13	89	20	24	25	29	17	19	27	28
Geographic Areas	**No.**	**North Penins'la**	**N stream Valley E**	**Central Ridge N&NW Stream valley**			**Central Ridge &West cliff**				**South Plateau Escarpment**	**South Stream Valley Lowlands**						**SE Cliff**	
ARTEFACT TYPES																			
Cores	5	1		1									2			1			
Flakes	7								1				3	2		2			
Blades	1		1																
Scrappers	1						1												
Hammer stones*	27												11	7	1			8	
Fire cracked rock	14			4				4	3								1	1	1
Coinchoidal fracture unknown	31				1		1		4				18	3		1		2	1
No data	112	8		6	3	1	1	2	6	2	5	1	48	17		3	1	7	
TOTAL	**198**	**9**	**1**	**22**	**4**	**1**	**3**	**6**	**14**	**2**	**5**	**1**	**82**	**29**	**1**	**7**	**2**	**18**	**2**

* Not locally sourced

6% of the locally sourced rhyolitic rock collected from archaeological contexts was made into flake tools. This disinclination to use local rock as tools may be due to (i) cultural factors not identifiable in the archaeological record, making obsidian the preferred choice for flake tools, or because (ii) the islanders had inhabited the island for only a short period and so did not have enough time to effectively utilise this local rock beyond construction purposes. These points will be discussed further at the end of Chapter 5.

Flakes

Flake material recovered from the Poor Knights Islands is dominated by obsidian, however smaller amounts of other flake material including chert and local rhyolitic rock were also identified. Flakes are evidence of flake tool manufacture. Identifying the exotic sources of the different stone used can give insights into social, economic and political connections between the inhabitants of Tawhiti Rahi Island and other Māori communities.

Chert

A total of 35 chert artefacts were recorded on Tawhiti Rahi Island, comprising of one core and 28 flakes of banded (1), grey (4) and yellow (26) material (Table 5.29). The yellow chert is made up of 26 small to medium sized pieces and only one confirmed flake. The grey chert however is made up of 3 large flakes and one single platform core.

Discussion

These chert artefacts are non-local and were visually identified by the stone's distinctive grey or yellow colours as being Onerahi chert. As a resource this chert is found in multiple outcrop locations around the foreshore of Whangārei Harbour on the adjacent Northland east coast. Yellow Onerahi chert is found in all but one of these outcrops and it is this that makes up the majority of the Tawhiti Rahi assemblage (30) along with five grey artefacts. Tool types found in the yellow chert include 25 small to medium sized pieces that are debitage or broken flakes, and five confirmed flakes. The grey Onerahi chert tool types consists of four Onerahi grey chert samples made up of three large flakes, one small piece, and one single platform core. This grey material is only found at Tapu point on the inner part of Whangārei harbour (Latham pers. comm. 2014).

All the chert located on Tawhiti Rahi Island was found at the southern end of the island in only one site (R06-24) and only within a small 3 x 2 m area of the total area excavated (E38-40, N42-43). Found in various spits that range from 0 to 20 cm deep, it is thought that this cluster of material represents a small single event knapping area within the residential terrace features. A lack of any clear stratigraphic layering is probably due to extensive bio-turbation damage caused by ground burrowing seabirds that invaded the site following the end of human occupation of the island. No edgeware damage or evidence of retouch was noted on the chert.

Table 5.29 Tawhiti Rahi Island chert artefacts

OBJID	Class	No.	Type	Colour	Artefact	Description piece (P) and flake (F)	Use damage	Location
1209	Chert	1	Onerahi	grey	Core	1 x Chert core P (182.8gm) 10-20 cm	-	R06-24 Hearth 1
1404	Chert	1	Onerahi	yellow	Piece	1 x Banded chert P (3.83gm) 10-20 cm	-	R06-24 Hearth 1
1658	Chert	11	Onerahi	yellow	Pieces	11 x Yellow chert F (29.36gm) 10-20 cm	-	R06-24 Hearth 1
1445	Chert	4	Onerahi	yellow	Flakes	4 x Yellow chert F . (7.60gm). 5-10 cm	-	R06-24 Hearth 1
1659	Chert	2	Onerahi	grey	Flakes	2xGrey chert large F (114.50gm). 5-10cm	-	R06-24 Hearth 1
1660	Chert	1	Onerahi	grey	Flake	1x Grey chert large F (45.43gm). 15-20 cm	-	R06-24 Hearth 1
1661	Chert	1	Onerahi	yellow	Flakes	1 x Yellow chert F (31.97gm). 10-15 cm	-	R06-24 Hearth 1
1662	Chert	2	Onerahi	yellow	Pieces	2 x Yellow chert P. (7.12gm). 10-15 cm	-	R06-24 Hearth 1
1663	Chert	6	Onerahi	yellow	Pieces	6 x Yellow chert P (37.05gm). 10-15 cm	-	R06-24 Hearth 1
1664	Chert	2	Onerahi	yellow	Pieces	2 x Yellow chert P (4.34gm). 20-25 cm	-	R06-24 Hearth 1
1665	Chert	1	Onerahi	yellow	Pieces	1 x Yellow chert P (0.87gm). 0-5 cm	-	R06-24 Hearth 1
1666	Chert	3	Onerahi	yellow	Pieces	3 x Yellow chert P (8.70gm). 0-5 cm	-	R06-24 Hearth 1

Adzes

A total of five complete adzes and two fragments of polished blade were identified on Tawhiti Rahi Island (Plate 5.34). Four were found in one site (R06-27) in the southern lowlands, with two of the four cached together immediately next to the obsidian lithic work floor. The fifth adze was located at the northern end of the island in association with terrace features, but not with any concentration of obsidian. All of the complete adzes conform to the Duff 2B category, in being of rounded quadrangular section that lack any tang, the front wider than the back and fully grind polished. These are presumed to be from the latter part of Māori prehistory since they were in use at the time of the first Europeans visitors (Golson in Best, 1977:308) and because none have been found in earlier assemblages (S. Best, 1976). The smaller fragments cannot be individually identified apart from the small adze fragment OBJ 1090 that has flaked off the cutting edge of the large adze [Point OBJID 60] – presumably through earlier use in the Carver site R06-27 (Table 5.30). Four types of rock are used to make these five complete adzes (Plate 5.34). Identification was made first by hand specimen analysis (by Russell Beck in 2013) and then by specific gravity where dry density was measured using water displacement. This followed a methodology set out by Hatherton and Leopard. The methodology used requires the adze to be dry weighed. Then a container of water is placed on the scale and centered (tare) to zero. Each adze is suspended on fishing line and suspended submerged in the container and the resulting wet weight recorded. The dry density specific gravity for each adze is calculated by dividing the dry weight by the wet suspended weight (Hatherton and Leopard, 1964: 608-614). The specific gravity results for the Poor Knights adzes were then entered into Table 5.30 and then compared to the known specific gravity of New Zealand rock (Table 5.31) and international rock (Table 5.32).

Plate 5.34 Five adzes recorded from Tawhiti Rahi Island. Using hand specimen analysis and then specific gravity measurement these have been identified as Argillite (1), Dolerite (2), Gabbro (1) and Greywacke (1). [Robinson 2013]

Table 5.30 Tawhiti Rahi Island adzes and adze fragments

OBJ ID	Class	No.	Taphonomy	Description	Density	Use/ damage	Location
50	Adze	Single	Nelson Argillite	1 x 2B adze. (82.26gm).	2.70065	N	R06-27
54	Adze	Single	Whangārei (?) Dolerite	1 x 2B adze. (298.66gm).	2.97374	Y	R06-27
60	Adze	Single	Whangārei (?) Dolerite	1 x 2B adze. (841.48gm). [Joins adze flake OBJ 1090]	2.98209	Y	R06-27
284	Adze	Single	Motutapu(?) Greywacke	1 x 2Badze. (260.39gm).	2.72787	Y	R06-09
1029	Adze	Single	Tangihua (?) Gabbro	1 x 2B adze. (825.9gm).	2.81878	Y	R06-27
1090	Adze	fragment	Dolerite	1 x adze flake. [Joins blade of adze OBJ60]	-	-	R06-27
1091	Adze	fragment	Basalt	1 x adze flake.	-	-	R06-27
1092	Adze	fragment	basalt	1 x adze flake.	-	-	R06-27

Table 5.31 Rock density measured as specific gravity for New Zealand rock *(Heatherton and Leopard 1964: pg 608 and 614)*

New Zealand locality		Range g/ cm3	Ave	Date: Page
North Island Greywacke and Argillite		-	2.63	1964:608
Northland basalt		-	2.68	1964:614, Table 3
D'Urville Island Greywacke and Argillite		-	2.81	1964:608
Gabbro Longwoods Bluff Ruapuke Island		-	2.91	1964:614, Table 3

Table 5.32 Rock density measured as specific gravity for rock found around the world *(Innitial Exploration Services 2014)*

International locality		**Range g/ cm3**	**Ave**	**Date: Page**
Diabase (alternative term for Dolerite)	Alden	2.50 – 3.20	2.91	2014; 1
Gabbro	Alden	2.70 – 3.50	3.03	2014; 1
Greywacke		2.60 – 2.70	2.65	2014; 2

The first adze [Point OBJID 50] appears as a fine grained argillite. The sourcing of this adze is unclear, as the density reading of 2.7g/ cm3 falls between that of D'Urville Island (2.81) and from the North Island (2.63) for greywacke and argillite, but closely matches the international database argillite density range of 2.60-2.70. In the balance, its appearance still suggests that it is sourced from D'Urville Island situated at the top of the South Islandof New Zealand (P.Latham pers. comm 2014; R. Beck pers. comm 2014). The next two adzes [Point OBJID 54 & 60] are a common type of adze encountered in the Northland region, and have a dark polished appearance with white inclusions. Since they both have feldspar inclusions that have crystalised prior to the inclusion of pyroxene, these have been identified as North Island dolerite that is known to exist in the form of dykes at the Whangārei Heads (per's comm. P Latham; per's comm. R Beck; Allen 1951:297). Both of these adzes had a very similar density of around 2.98. Although there are no published records of the density of Whangāreidolerite, both of these adzes fall within the international diabase/dolerite density range of 2.6-3.0. The fourth adze [Point OBJID 284] is harder to identify. Initially thought to be a form of pale green gabbro, it has now been identified as a fine grained and weathered greywacke with magnetite inclusions visible under the microscope. With a density of 2.72, it falls half way between the density of North Island greywacke (2.63) and South Island greywacke (2.81). Like OBJID 50 whose distinctive physical characteristics suggested a southern D'Urville Island origin, the visual characteristics of this adze suggest a northern origin possibly being Motutapu greywacke found in outcrops in and around Motutapu Island in the Auckland Harbour that was exploited throughout prehistory (Davidson 1981: 111). However there are no published density measurements for this source to confirm or deny this. The final adze [Point OBJID 1029] is greenish grey in colour with feldspar lathes visible in the eroded parts of the adze. This has been visually identified as gabbro, and this is backed up by a density measure consistent with a source probably located somewhere in the Tangihua massif that is distributed in at least eight locations in Northland (per's comm. P. Latham; S. Best 1976:69).

Diorite and gabbro are closely related igneous rock that contain equal proportions of calcium feldspar and pyroxene and differ primarily in their medium or large crystal/grain size (McCarthy & Rubidge, 2005:34). The larger the crystal the stronger and harder the rock is (Gavira and Frances 2008:33). Apart from unpublished experimental work carried out Russell Beck (R. Beck pers. comm 2014); there has been no published archaeological research into the characteristics of New Zealand dolerite that might make it desirable for adze creation. However Simon Best did investigated gabbro in the 1970s. He determined that it was only used for the later type 2B adzes and was a very hard rock ideally suited for withstanding impact stresses and that was shaped into adzes by grinding, not flaking. Gabbro - and by inference the similar Dolerite - out performed the basalt and argillite flaked adzes used for adzes in the initial period of Māori settlement (S. Best, 1976; 1977).

Discussion

All of the adzes apart from the argillite adze [Point OBJID 50] show edge wear damage. The larger of the two gabbro adzes [Point OBJID 1029] has lost its cutting edge completely. Since four of the five adzes are located within a 20 m radius within the Carver site (R06-27), it is possible that the adzes were brought here to be re-sharpened. The re-sharpening of tools is an ongoing need especially if used to 'punch' through the compacted white ash to form post holes as was noted in the excavated site R06-24 (Chapter 5 Part II). The identification of a small fragment of adze blade [Point OBJID 1090] from the large dolerite adze [Point OBJID 60] may reflect this process, in that this flake retains the adze's sharp cutting edge and appears to have come off during wood working. This damage clearly predated the current harsher edge damage that reflects a subsequent impact against a hard surface like the concreted ash found in the Hearth site R06-24. This refurbishment argument may provide further support for the traditional view that this site was the location of a specialist stone tool maker (Hetaraka quoted in Robinson, 2004:22 & plate 7)

It is argued from the design (Duff 2B) that all the complete adzes recovered from Tawhiti Rahi Island date to the latter period of prehistoric settlement. The gabbro and dolerite 2B adzes formed primarily by grinding are commonly associated with forest clearance, and the location of lithic sources for both of them shows social connections back to the Northland mainland. The argillite 2B adze is also from this late period, but is made from less hard material that early in prehistory was often associated with a range of different adzes types thought to be associated with canoe construction (Best, 1977). This seems appropriate for The Poor Knights, whose archaeology is dominated by gardens, but which as an island would have of a necessity retained a high reliance on canoe transportation for all forms of communication.

The use of specific gravity to source stone tools remains a viable technique in the absence of more precise sourcing methods. However it will only become an effective tool when artefacts can be compared to density measures taken from a large comparative data set of well-provenanced archaeologically recovered stone tools.

Water rolled boulders

No water rolled rock is native to the Poor Knights Islands, and so the water rolled boulders wereimported to the island. Water rolled boulders are a subset of 'water rolled rock' that excludes cobbles (5-12 cm) and pebbles (2-5 cm) that are discussed under the 'Hammer stone' heading. The water rolled boulders are defined here as 45 large water rolled basalt boulders (or fragments) measuring within the range of 20-45 cm long by 10-25 cm wide that can't be held in one hand. All but two are restricted in distribution to the southern lowlands and are found for the most part as isolates on individual terraces, with 11 in the dispersed settlement (R06-22, 23& 25) overlooking Camp Bay, one at the Carver site (R06-27) on the eastern cliff top, one in the Southern Garden Valley near the seasonal stream (R06-28) and eight in the specialist canoe terrace (R06-19). A further 20 are found within the cave site (R06-17) (Plate 5.35). 13 are scattered around the floor of the cave, but seven others form a straight boundary line separating the inner and outer caves. The only two examples found on the plateau are located in the open settlement of R06-85 (Table 5.33).

These boulders are interpreted as performing a number of functions. The 23 single boulders on individual terraces in the southern lowlands (R06-19, 22, 23, 25 27 & 28) are probably anvil stones. These may be associated with the production of flake tool assemblages using a hammer stone however this is unlikely since none show any sign of impact damage and other specialist flaking floors like R06-05 with extensive obsidian deposits lack any large boulders. A more likely

Plate 5.35 Cave site R06-17: Water rolled boulder linear arrangement.[Feature OBJ ID 2911]. [Walter 2005 IMG_3777]

Table 5.33 Tawhiti Rahi island water rolled boulder(WRB) artefacts

OBJ ID	Class	No	Material	Description	damage	Location
989	boundary	1	basalt	WR boulder. 1 of line of 7. surface	-	R06-17
990	boundary	1	basalt	WR boulder. 1 of line of 7. surface	-	R06-17
991	boundary	1	basalt	WR boulder. 1 of line of 7. surface	-	R06-17
992	boundary	1	basalt	WR boulder. 1 of line of 7. surface	-	R06-17
993	boundary	1	basalt	WR boulder. 1 of line of 7. surface	-	R06-17
994	boundary	1	basalt	WR boulder. 1 of line of 7. surface	-	R06-17
995	boundary	1	basalt	WR boulder. 1 of line of 7. surface	-	R06-17
996	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
997	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
998	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
999	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1000	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1001	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1002	Anvil	1	Basalt	WR boulder. Isolate. surface	-	R06-17
1003	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1004	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1005	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1006	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1007	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-17
1556	Anvil	1	basalt	WR boulder fragment. TP 1 9-13 cm	-	R06-17
78	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-19
79	Anvil	1	basalt	WR boulder. Isolate 30x20 cm surface	-	R06-19
80	Anvil	1	basalt	WR boulder. Isolate 30x20 cm surface	-	R06-19
81	Anvil	1	basalt	WR boulder. Isolate 30x20 cm surface	-	R06-19
82	Anvil	1	basalt	WR boulder. Isolate 30x20 cm surface	-	R06-19
83	Anvil	1	basalt	WR boulder. Isolate 30x20 cm surface	-	R06-19
84	Anvil	1	basalt	WR boulder. Isolate 30x20 cm surface	-	R06-19
85	Anvil	1	basalt	WR boulder. Isolate 30x20 cm surface	-	R06-19
11	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
12	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
13	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
21	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
22	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
23	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
29	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
30	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
112	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
113	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-22
114	Anvil	1	basalt	R boulder. Isolate. surface	-	R06-22
31	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-23
1467	Anvil	1	basalt	WR boulder. Isolate. surface	Firecrack'd	R06-25
56	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-27
70	Anvil	1	basalt	WR boulder. Isolate. surface	-	R06-28
1651	Cooking?	1	basalt	WR boulder fragment surface	-	R06-85
1652	Cooking?	1	basalt	WR boulder fragment surface	-	R06-85

scenario to explain the lack of damage is that these were anvil stones on which cooked fern root was beaten with a wooden fern root pounder (Coster, 2015 pers comm). Those isolated examples (12) on the surface of the cave floor may also be anvils, however the seven forming a line may well form a symbolic boundary between the inner sacred (tapu) cave and the outer profane (noa) cave where food was cooked and consumed. This possibility is supported by historic evidence of ceremonial hair cutting occurring somewhere in this cave (Wilson, 1959). The fragment of water rolled rock found in the cave Test Pit 1 [Point OBJID 1556] is too small to determine if it came from large water rolled boulder or from smaller water rolled pebbles. It could also just be shatter from small water rolled fire cracked rock utilised in one of the three fire-places visible on the floor of the cave. If the tapu/noa argument has some validity, it may be significant that the two examples found up on the central plateau in the open site of R06-85 are only fragments of larger boulders, and that they are found among faunal evidence of cooking.

Discussion

The distribution of water rolled boulders is similar to hammer-stones in their near total presence in the southern lowlands, and could reflect the use of boulders as anvils. The suggestion that some of the boulders are used for ceremonial 'tapu' purposes, separating sacred from profane areas, raises the possibility that some of the isolated boulders in the southern lowlands may instead be associated with sacred practices especially since none show any impact damage from percussion. This idea may be further supported by the fact that all these boulders were formed in high energy streams or coastal zones that do not occur on any of the Poor Knights Islands. If this is a recent settlement, and if these boulders have more than a functional use as anvils for obsidian to be reduced, then we can't rule out the possibility that these are 'Moari' stones brought from (and maintaining a connection with) the place that the islanders emigrated from. Further XRF analysis of these archaeological basaltic boulders and of the naturally occurring basalt found in streams on Great Barrier and on the Northland mainland is needed to determine their geographical origin and by default, whether trade and exchange of such items was focused east from the mainland or north-west from Great Barrier Island. These boulders are some of the most interesting of the lithic artefacts recovered from this investigation. Their unmodified position in a landscape that was abruptly abandoned hints at belief practices that are normally invisible within New Zealand's prehistoric archaeological record.

Hammer-stones

This class of artefact is defined as small water rolled pebbles measuring less than 12 cm in diameter that can be held by one hand and that are interpreted as being hammer stones. Such dense hard pebbles were used for the reduction of cores of rock with coinchoidal flaking characteristic so as to produce flake tools. A total of 39 were recorded during the field work (Table 5.34). These ranged in weight from 6 to 180 g and are made from various types of hard strong rock including basalt (11), jasper (1) quartz (1) which does not naturally occur on the Poor Knights Islands, as well as various rhyolitic rock such as tuff (6), siliceous tuff (2), and sinter (18) that does naturally occur on these islands. However all of these artefacts must have been imported, since the island lacks the necessary permanent streams or high energy coast platforms or beaches needed to create their water rolled appearance. Siliceous sinter is reported from the Kuaotunu Peninsula in the Coromandel region (Best, 1977: 318) but there may well be other as yet unidentified sources elsewhere. The Jasper hammer stone [Point OBJID 1380] may be from the spherulitic red jasperoid quartz that was reported from the north shore of McLeods Bay Whangārei Harbour. This is found only a few hundred meters west of a dyke of dolerite that may be the source of two of the adzes [Point OBJID 54 & 60] discussed previously.

Despite the numerous isolates, scatters and small concentrations of obsidian present on the northern plateau that makes up the northern two thirds of the island, only one hammer stone was identified here at the central ridge open site of R06-11. This is unexpected considering that 196 of the 851 obsidian records found on the plateau, and of these, 23 cores are present in five sites (R06-5, 9, 11, 12 & 85) with extensive obsidian debris fields that implies that reduction using hammer stones occurred at these locations. The finding of a single hammer stone not associated with obsidian deposits at the only landing site for Tawhiti Rahi Island at Camp Bay - R06-29(1) may reflect the process of importation rather than use. The final hammer stone was located on Aorangi Island near to some isolated obsidian flakes, and is uniquely made from a type of hard jasper. This may reflect the island's inhabitants being from a different hapu (group of extended families) and therefore having access to different sources of lithic material.

Discussion

Smaller sized water rolled rocks are made from strong durable material well suited for use as hammer stones. Hammer stones are used for the reduction of obsidian and other lithic material with coinchoidal fracture characteristics into flake tools. Their distribution in this study includes one being located on the adjacent island of Aorangi and 31 on Tawhiti Rahi. All but one of these last groupsare found in the southern lowlands. On Tawhiti Rahi the hammer stones are most likely to beassociated with obsidian flaking, since 29 of the 31 are found in direct association with extensive obsidian deposits in the Southern Lowlands at sites R06-24(11), R06-25(8) and R06-27(10). It may however be significant that only nine of these show evidence of end damage or

Table 5.34 Tawhiti Rahi hammer stone (HS)artefacts

OBJ ID	No.	Type	Type	Description	Depth (cm)	Use/ damage	Location
1380	1	HS	Jasper/basalt?	Large pebble	Surface	-	Aorangi
1373	1	HS	quartz	Small pebble	27 cm	Abrasion	R06-24
620	1	HS	rhyolitic tuff	Small pebble	Surface	-	R06-25
525	1	HS	rhyolitic tuff	Fine grained pebble	Surface	-	R06-25
542	1	HS	rhyolitic tuff	Small pebble	Surface	-	R06-25
657	1	HS	rhyolitic tuff	Small pebble	Surface	-	R06-25
672	1	HS	rhyolitic tuff	Small pebble	Surface	-	R06-25
1211	1	HS	rhyolitic tuff	Medium pebble	Surface	-	R06-27
1643	1	HS	siliceous tuff	Rough grained pebble	15-20		R06-24
1441	1	HS	siliceous tuff	Medium pebble	Surface	-	R06-27
1374	1	HS	sinter	Small variable grained pebble	27	-	R06-24
1375	1	HS	sinter	Medium small pebble	5-10	End ware	R06-24
1376	1	HS	sinter	Medium pebble	5-10	End ware	R06-24
1377	1	HS	sinter	Medium pebble	5-10	-	R06-24
1379	1	HS	sinter	Medium pebble	10-20	-	R06-24
1385	1	HS	sinter	Medium small pebble	0-5	-	R06-24
1644	1	HS	sinter	M x medium small pebble	15-20	Broken	R06-24
1356	1	HS	sinter	Medium sintered pebble	Surface	-	R06-24
1366	1	HS	sinter	Large sintered pebble	0-10	-	R06-24
523	1	HS	sinter	Medium pebble	Surface	Broken	R06-25
655	1	HS	sinter	Medium pebble	Surface	End ware	R06-25
1378	1	HS	sinter	Medium pebble	Surface	-	R06-25
1024	1	HS	sinter	Pebble	Surface	-	R06-27
1210	1	HS	sinter	Large pebble	Surface	-	R06-27
1212	1	HS	sinter	Medium pebble	Surface	-	R06-27
1213	1	HS	sinter	Large finely laminated pebble	Surface	-	R06-27
1214	1	HS	sinter	Large finely sintered pebble.	Surface	-	R06-27
1215	1	HS	sinter	Large sintered pebble	Surface	-	R06-27
1639	1	HS	basalt	Large pebble	Surface	End ware	R06-11
240	1	HS	basalt	6 cm diameter pebble	Surface	-	R06-17
115	1	HS	basalt	Pebble	Surface	-	R06-19
117	1	HS	basalt	Pebble	Surface	-	R06-19
121	1	HS	basalt	10 cm diameter pebble	Surface	-	R06-19
35	1	HS	basalt	Pebble	Surface	End ware	R06-25
575	1	HS	basalt	Large pebble	Surface	Fire cracked	R06-25
576	1	HS	basalt	Medium pebble	Surface	Fire cracked	R06-25
116	1	HS	basalt	Pebble	Surface	-	R06-27
1098	1	HS	Basalt	Pebble	Surface	End ware	R06-27
51	1	HS	Basalt	Pebble	Surface	-	R06-27

breakage that can be attributed to actual use as hammer stones, and of these, eight are found in the Hearth site R06-24). (Table 5.34; Plate 5.36).

The rock used for these artifactsall comes from an off island source due to its water rolled nature that could not have happened on this island. It is beyond the scope of this current research to determine where exactly these water rolled pebbles came from; however there are references to jasper and quartz being naturally occurring in the Whangamata area of the Coromandel Peninsula (Jolly, 1978). The fact that and jasper and siliceous material were also noted in an archaeological context from Haratonga Bay on Great Barrier (Law, 1972:91) shows that other sites in the mid-north area have similar lithic assemblages. All that can be said about their sourcing then is that water rolled examples of basalt, sinter and rhyolitic water rolled pebbles must have been obtained from coastal and/or riverine environments that are most commonly found in the larger land masses such as the Coromandel, Auckland/Northland mainland and Great Barrier Island.

The presence of obsidian debris fields over the entire island, but the near total restriction of hammer stones to the south, is matched by a similar pattern with water rolled boulders that might have been used as anvil stones. If occupation between the north and south was contemporary, then this may reflect a functional difference between core/primary sites to the south where hammer-stone and anvil techniques were used in permanent lithic work floors, and also in outlier

Plate 5.36 Site R06-11: Abasalt hammer stone. Shows end damage from use[Point OBJID 1639] [Robinson 2013] [DSC_0068, & DSC_0070]

or secondary sites to the north where hand-held knapping with portable hammer-stones was used. If occupation was not contemporary, it could instead reflect an earlier focus of settlement in the south, and a later northern expansion that was not complete when the island was abandoned.

Miscellaneous tools

This class of artefacts is a 'catch all' for the remaining tool artefacts recorded in the GIS. A total of eight tools were identified from the survey and the excavation on Tawhiti Rahi Island. These include one quartz drill point [Point OBJID 1094], two rhyolitic tools in the form of a scrapper [Point OBJID 249] and a blade [Point OBJID 1101], and five sandstone tools that include three abraders [Point OBJID 1395, 1396 & 171], one fine grained file/chisel/lure (Plate 5.37) [Point OBJID 1110] and one sandstone grindstone [Point OBJID 220] (Plate 5.38; Table 5.35).

The quartz drill and siliceous blade were found at the North Valley East cliff settlement near to the light beacon. The rhyolitic scrapper was found on the west side of Puketuaho Hill R06-12. The open settlement site R06-85 on the central ridge 200 m to the south of Puketuaho Hill contained a rough grained irregular shaped sandstone abrader and the extensively worked fine grained sandstone grindstone that has at least four longitudinal groves resulting from the filing/abrading of unknown artefacts. The R06-24 Hearth site excavation in the southern lowlands had two rough grained irregular shaped sandstone abraders in the central hearth 1 sub-site, while Hearth 2 sub-site contained the hard fine grained sandstone chisel/file. The body of this tool is finely shaped, however both ends have been broken, making a definitive interpretation of function uncertain.

Discussion

These tools turn up at the north, central and southern parts of the island and so do not have any particular geographic focus. The class of sandstone dominates, however the extreme variation in grain size suggests that this should be divided into 'rough grain' and 'hardened' sub-types. Considering the extensive lithic work floors associated with obsidian flake tool production, it is surprising how few tools are present. Even combined with the adzes, we still have a minimum number of twelve (12) confirmed tools that are not obsidian (or hammer stones used to flake obsidian) from the whole island.

Plate 5.37 Site R06-85: An extensively worked fine grained sandstone grindstone. This has four longitudinal groves resulting from the filing/abrading of unknown artefacts. [Point OBJ ID 220]. [Robinson 2013 DSC_0123 & DSC_0124]

Plate 5.38 Site R06-24: A fine grained file/chisel fragment or fishing lure with a longitudinal groove andbroken ends.[Point OBJID 1110]. [Robinson 2013 DSC_0193]

Table 5.35 Tawhiti Rahi Island miscellaneous lithic tools artefacts

OBJ ID	Class	No.	Type	Description	Use/ damage	Location
1094	Drill point	1	quartz	1 x small quartz fragment tool. (2.60gm) Surface	-	R06-8
1101	Blade	1	siliceous rhyolitic tuff	1 x small blade tool. Partial cortex. (1.2gm) Surface	-	R06-8
249	Scrapper?	1	siliceous tuff	1 x scrapper tool. Partial cortex. (52.0gm) Surface	-	R06-12
1395	Abrader	1	sandstone	1 x sandstone tool. Rough grained (12.93gm) 0-5 cm	-	R06-24
1396	Abrader	1	sandstone	1 x sandstone tool. Rough grained (7.99gm) 0-5 cm	-	R06-24
1110	File/chisel	1	sandstone	1 x fine grained tool fragments (26.14gm) Surface	broken	R06-24
171	Abrader	1	sandstone	1 x sandstone tool. Rough grained (0.00gm) Surface	-	R06-85
220	Grindstone	1	sandstone	1 x multi-grooved fine grained grindstone tool (213gm)Surface	abrasion	R06-85

Ochre

On Tawhiti Rahi Island a total of 49 small clumps of ochre weighing in total 444 g were located in nine sites (Table 5.36). Since ochre is not naturally occurring on this volcanic island, it must have been imported. Current research does not indicate where such sources might be located but both Great Barrier Island and the Northland mainland are the nearest localities that contain the required clay soils.

The location of the ochre artefacts on the island mirrors the distribution of other portable material culture items, being tightly clustered in the north, center and south of the island. In the north valley (east cliff) site, four samples were found in a terraced habitation site among obsidian (R06-9). At the complex settlement site of Puketuaho in the center of the island (R06-12) and at the raised knoll site on the western cliffs (R06-14) isolated single clumps were recorded. Between these, the open site contained seven samples weighing 52.64 gm's,this is the only known location of yellow ochre on the island (R06-85). The cave site in the south (R06-17) contained two samples, one on the surface and one found 9-13 cm deep in Test pit 1. The largest number and weight of ochre was located in the dispersed settlement in and around the Hearth site, where a total of 19 samples weighing 86 g were found (R06-24). Isolated examples of ochre were also found at the base and the top of the plateau escarpment, near to the existing track line. Since this track follows the path of least resistance up the slope, the route is likely to have been used in prehistory. As such these items may just be lost items with no direct relationship to any particular site. Finally the Carver site in the south overlooking the eastern cliffs contained seven ochre samples weighing 128.52 g on a small natural rock shelf immediately adjacent to the lithic work floor (R06-27).

Table 5.36 Red and yellow ochre

OBJ ID	Class	No.	Type	Description	Use/ damage	Location
279	Ochre	1	red	Fragment Surface(6.30gm)	-	R06-09
280	Ochre	1	red	FragmentSurface (?gm)	-	R06-09
281	Ochre	1	red	Fragment Surface72.66gm)	-	R06-09
282	Ochre	1	red	Fragment Surface (3.26gm)	-	R06-09
1533	Ochre	1	red	Fragment Surface (14.03gm)	-	R06-12
1535	Ochre	1	red	Fragment Surface (29.15gm)	-	R06-14
1010	Ochre	1	red	Fragment Surface (?gm)	-	R06-17
1555	Ochre	3	red	Fragment 9-13 cm(1.03gm)	-	R06-17
237	Ochre	1	red	FragmentSurface(?gm)	-	R06-22
1448	Ochre	1	red	Fragment5-10 cm(9.81gm)	-	R06-24
1518	Ochre	2	red	Fragment 20-25 cm(31.12gm)	-	R06-24
1519	Ochre	2	red	Fragment 0-5 cm (3.09gm)	-	R06-24
1520	Ochre	2	red	Fragment 0-5 cm(17.26gm)	-	R06-24
1526	Ochre	1	red	Fragment 5-10 cm(3.54gm)	-	R06-24
1527	Ochre	6	red	Fragment 0-5 cm(7.81gm)	-	R06-24
1528	Ochre	2	red	Fragment Surface (5.06gm)	-	R06-24
1529	Ochre	1	red	Fragment 0-5 cm (8.28gm)	-	R06-24
59	Ochre	1	red	Fragment Surface 25.49gm)	-	R06-27
1093	Ochre	1	red	Fragment Surface (90.5gm)	-	R06-27
1517	Ochre	1	red	Fragment Surface (1.72gm)	-	R06-27
1530	Ochre	2	red	Fragment Surface (6.75gm)	-	R06-27
1538	Ochre	2	red	Fragment. Surface (4.06gm)	-	R06-27
173	Ochre	1	-	Fragment Surface (?gm)	-	R06-85
216	Ochre	1	-	Fragment Surface (?gm)	-	R06-85
221	Ochre	1	-	Fragment Surface(?gm)	-	R06-85
264	Ochre	1	red/ yellow	Fragment Surface (?gm)	-	R06-85
305	Ochre	3	ochre	Fragment Surface (22.82gm)	-	R06-85
1600	Ochre	1	red	Fragment Surface (17.66gm)	-	R06-85
1601	Ochre	2	red	Fragment Surface(9.59gm)	-	R06-85
1536	Ochre	1	red	Fragment Surface(2.60gm)	-	R06-89
1531	Ochre	1	yellow	Fragment Surface (49.97gm)	-	Roimata Pt
TOTAL		**49**		**443.49gm**		

Discussion

Ochre is a term used in world archaeology to describe a family of pigments that in the New Zealand context appear limited to red and yellow colours. The pigment is a clay whose differing trace elements produce different colours. Red ochre for example is caused by the presence of the iron oxide hematite, while yellow ochre is due to hydrated iron oxide otherwise known as limonite. Ochre's use as paint dates back at least 100,000 years, and at the time of first European contact, Māori were making extensive use of it. Often it was mixed with fish oil to produce a colouring agent for use on the skin as well as being applied to wood where it acted as a preservative and a colour (Menotti & O'Sullivan, 2013:201). In particular, its use on carvings associated with buildings (Whare Hui) and war canoes (Waka Taua) was said to provide up to 30 years of protection (http://www.answers.com/topic/ochre: 25/03/14). It also has religious associations and on occasions in New Zealand has been found applied to bone in burial sites. Ochre was also applied to bodies as well as the hair – which is a tapu object.

The location of ochre in three constrained localities on Tawhiti Rahi Island suggests some functional activity here. Clearly the ochre is not locally sourced, so was imported, but from where is not currently known. The only example of ochre being used is on the carved wooden panel [Point OBJ 1101], where remnant deposits of red ochre paint presumably in fish oil solution is visible in the intricacies of the spiral carved design (see floral section later this chapter for more details). The successful use of XRF to identify ochre sourcing has recently occurred in the USA (Popelka-Filcoffetal, 2008; Eiselt et al, 2011) and it could become a useful sourcing technique in New Zealand if the location of naturally occurring ochre deposits of mineral ochre can be identified and shown to be geochemically differentiated.

5.3.2 Faunal material

An assemblage of faunal shell and bone material was identified on Tawhiti Rahi Island (Figure 5.59). This material was located in and around five sites including R06-11 and 85 up on the northern plateau, and in the southern lowlands at the cave site R06-17, the dispersed settlement site R06-24 and the Carver site R06-27. Material from sites R06-11, 17 and 24 has not been processed, and so this analysis is based on material from only sites R06-27 and R06-85. The analysis of this faunal assemblage is discussed in two parts. Section 5.3.2.1 looks at all non-human faunal bone, while Section 5.3.2.2 examines a range of shellfish species.

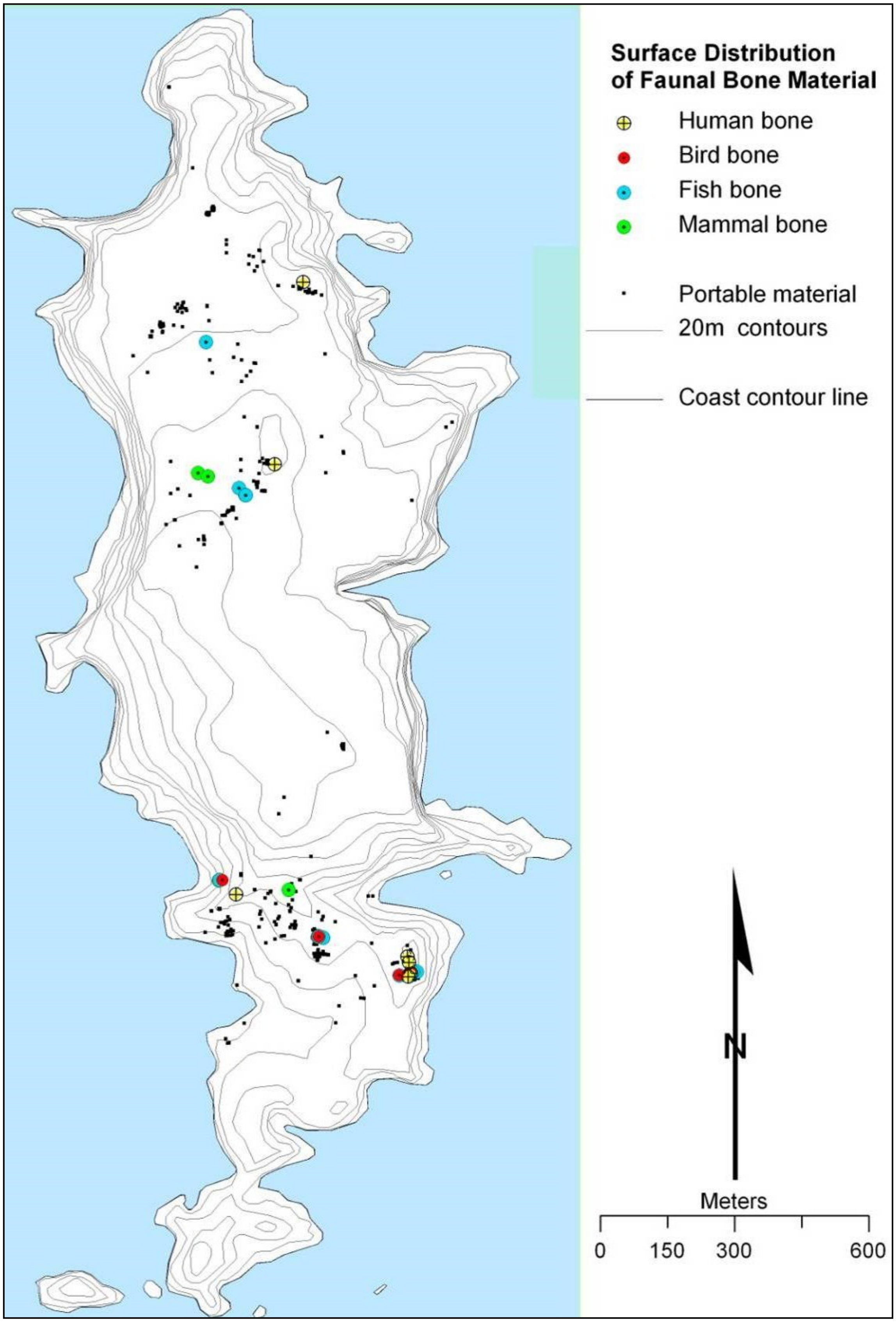


Figure 5.59 Tawhiti Rahi Island distributions of faunal bone and human remains.

5.3.2.1 *Fish, bird and mammal bone*

A selection of previously unexamined faunal bone material was analysed from four isolate sites (R06-11. 14. 17 & 20) and three surface concentrations of midden found at the specialist Carver site R06-27, at dispersed hamlet Hearth site R06-24 and at open site R06-85 (Table 5.37).

Table 5.37 Faunal bone

OBJ ID	Class	No.	Description	MNI	Location
Bird					
63	Bird Bone	Scatter	unidentified bird bone (?gm) Surface	-	R06-27
1216	Bird Bone	Single	1 x bird femur (broken) (0.44gm) Surface	-	R06-27
1252	Bird Bone	Single	1 x bird femur. (0.88gm) Surface	-	R06-17
1540	Bird Bone	Scatter	1 x unidentified bird bone. (0.36gm) 0-5 cm	-	R06-24
-	Bird Bone	Single	1 x humerus P.bulleri. (Buller sh) (?gm) Surface	-	R06-85
-	Bird Bone	Single	1 x ulna P. griseus (Sooty sh) (?gm) Surface	-	R06-27
-	Bird Bone	Single	4 x various bones Puffinus sp.(gen)(?gm) Surface	-	R06-27
Mammal					
152	Dog Bone	Single	1 x dog atlas vertebrae. (?gm) Surface	-	R06-14
98	Dog Bone	Single	1 x dog tibia (?gm) Surface	-	R06-20
506	Dog Bone	Single	1 x dog? Metatarsal fragment (?gm) Surface	-	R06-24
1306	Dog Bone	Single	1 x unidentified bone frag. (0.42gm) Surface	-	R06-27
153	Seal Bone	Single	1 x Furseal lumbar vertebra. (?gm) Surface	-	R06-85
1011	Pig Bone	Single	1 x mandible section with teeth. (? gm) Surface	-	R06-85
Fish					
209	Fishbone	<Null>	Unidentified fish bone (?gm) Surface	-	R06-11
1508	Fishbone	Single	1 x fish bone rib (0.07gm) Surface	-	R06-17
1030	Fishbone	Scatter	Scatter of fishbone. (31.12gm) Surface	-	R06-24
64	Fishbone	<Null>	Unidentified fish bone (?gm) Surface	-	R06-24
1217	Fishbone	Large conc	Small unidentified fishbone. (25.87gm) Surface	-	R06-24
1334	Fishbone	Single	1 x shark/ray (0.62gm) Surface	-	R06-24
1347	Fishbone	Small conc	Scatter of fishbone (5.45gm) 0-5 cm	-	R06-24
1539	Fishbone	Scatter	2 x mandible fragments. (1.10gm) 0-5 cm	-	R06-24
1363	Fishbone	Single	1 x unidentified fish vertebrae. (0.53gm)5-10 cm	-	R06-24
1330	Fishbone	Single	1 x unidentified fishbone. (0.09gm) Surface	-	R06-27
175	Fishbone	<Null>	Unidentified fish bone (?gm) Surface	-	R06-27
245	Fishbone	Single	1 x large fish vertebrae. (?gm) Surface	-	R06-27
1685	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-27
1686	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-27
1687	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-27
1688	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-27
1689	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-27
1690	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-27
1692	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-85
1693	Fishbone	Small conc	Unidentified fishbone. APP 7. (?gm) Surface	-	R06-85

Fishbone dominated the collection and was analysed by Yolanda Vogel (Appendix 7i), and the remnant non-fishbone bone was analysed by Sheryl McPherson (Appendix 7ii). Results of these two analyses are presented in Tables 5.38 and 5.39 and briefly discussed. In Section 5.3.2.2, the range and distribution of shellfish encountered on Tawhiti Rahi Island are set out and then discussed.

Fishbone (Vogel, Appendix 7i)

Fishbone totaling 476 g dominates the faunal collection recorded from Tawhiti Rahi Island (Table 5.35). From a total of 1501 pieces of fish bone analysed, 103 (6.8%) were identified to taxonomic level, and a further 1036 (68.8%) identified to element. Unidentifiable fragments (366) account for 24.4% of the assemblage. A total of fourteen taxa are represented in the assemblage (including that currently unable to be identified), with eight identified to species level, one to genus, three to family and one to sub-class. Seven of these, Snapper (*Pagrus auratus*), (spotty) *Notolabrus sp.*, groupers, rock cod, etc (Serranidae), barracouta (*Thyrsites atun*), Leather jacket (*Parika scaber*), moral eel (Muraenidae), and the as yet unidentified species accounted for 84% of the assemblage based on Minimum Number of Individuals (MNI), with the first five yielding from 11 to 20% of the assemblage each. Minimum number of individual and Number of Specimens Present counts for all taxa are shown in Table 5.38. Full details of the fishbone analysis are detailed in Appendix 7i.

Table 5.38 Faunal fishbone identified from sites R06-27 and R06-85

Species	Common Name	NZ or tropics	MNI	NISP
Pagrus auratus	Red Snapper	NZ + tropics	9	29
Notolabrus sp.	Spotty	NZ	6	14
Serranidae	Grouper/rock cod	NZ + tropics*	6	22
Thyrsites atun	Barracouta	NZ + tropics	6	11
Parika scaber	Leather Jacket	NZ	5	6
Muraenidae	Moral eel	NZ + tropics	3	7
Not in Collection**	Unidentified		3	6
Psuedophycis bachus	Red cod	NZ + tropics	2	2
Arripis trutta	Kahawai	NZ + tropics	1	1
cf Carangidae	Jack Mackerel	NZ + tropics	1	1
cf Trachurus novaezelandiae	Yellowtail horse mackerel	NZ + tropics	1	1
Elasmobranchii	Cartilaginous fish	NZ + tropics	1	1
Nemadactylus macropterus	Tarakihi	NZ	1	1
Polyprion oxygeneios	Hapuka	NZ	1	1
TOTAL			**46**	**109**

* The Serranidae identified in the assemblage is not a New Zealand species

** No match for this species was found in the reference collection utilised, and it therefore remains unidentified.

Discussion

The Poor Knights Islands lie off the coast of the north east North Island and are seasonally subject to the East Auckland Current (Stanton et al, 1997, cited in Denny et al, 2003, cited in Vogel, Appendix 7i). This results in the waters around these islands containing both higher species diversity than is normally expected in New Zealand and also the appearance of tropical species such as moray eels (Francis 1996 cited in Vogel, Appendix 7i). The island itself is characterised by steep cliffs and rocky reefs that are likely to limit shore based fishing in favour of canoe based techniques. Although the minimum number of individuals identified in the fish assemblage is small (43) the survival of many small and fragile bones suggests that the results have not been skewed by destructive taphonomic factors. All the taxa identified in this assemblage are still present today around the island (Denny et al 2003, cited in Vogel, Appendix 7i). All could have been caught relatively close to the island mostly using a baited hook or net, the exceptions being barracouta and kahawai, which are more likely to have been caught by trolling (Anderson 1997 cited in Vogel, Appendix 7i).

The presence of the tropical East Auckland current may explain why this assemblage does not follow the normal temperate region model where one or two species usually dominate (B. Leach 2006). The presence of a range of taxa within the assemblage despite its small size, including at least two more commonly associated with tropical environments, reflects the islanders' opportunity to obtain temperate fish species from Northland's coastal environment along with tropical fish species brought south in the East Australian/East Auckland current. In particular this may be the first time that the tropical Moray eel has been encountered in a New Zealand assemblage (Vogel, Appendix 7i). It is acknowledged that since only four species have MNI equal to or greater than 6, this assemblage is too small to be truly representative of the extent, type or timing of fishing carried out around this island in the past but it does create a 'presence' scenario suggesting that a broad collection strategy was being followed.

If this fish bone assemblage is a result of activities by people from the mainland travelling to the island to tend gardens, it may be representing a series of relatively short-term event. This would explain the generalised nature of fishing activities, with people catching what was readily available, either from the rocks or, more likely given the terrain, from stationary canoes, without targeting particular species. The fact that a major hapuka (*Polyprionoxygeneios*) fishing ground is located off the eastern coast of the Poor Knights (Hetaraka, 2008 and pers. comm. 2000) but only one such individual is present in the assemblage may support the theory that this reflects a generalisedrather than specialised fishing strategy.

From the total of 74 pieces of non-fishbone material (McPherson, Appendix 7ii), the analysis identified three classes consisting of bird, mammal and reptile, with some material unable to be identified (Table 5.39). Twenty two bones (30.1%) were identified to genus or species level, and a further 30 (41%) identified to class. Unidentified fragments (21) account for 28.9% of the assemblage. A total of seven taxa are represented in the assemblage, with four identified to species level and three to genus. The minimum number of individuals (MNI) represented in the assemblages is nine.

Table 5.39 Faunal non-fish bone

Class	Taxa	NISP	MNI
Bird			
	Puffinus bulleri (Buller shearwater)	1	1
	Puffinus griseus (Sooty shearwater)	1	1
	Puffinus sp. (general)	4	1
	Unidentified	26	n/a
Mammal			
	Sus scrofa(Feral pig)	1	1
	Canis familiaris (Domesticated dog)	2	1
	Otariidae sp. (Fur seal)	1	1
	Unidentified	2	
Reptile			
	Sphenodon sp. (Tuatara)	12	3
	Unidentified	2	
Unidentified		21	
TOTAL		**73**	**9**

A total of only seven records of bird bones were recorded in the GIS and all were found in the southern lowlands south of the plateau escarpment. Four of these are from small surface scatters at the Carver site R06-27 and are found in association with cooking and midden areas that also contain fishbone, charcoal and obsidian. The cave site (R06-17) contains a thick surface deposit of charcoal and burnt faunal bone material. Since most of this has yet to be analysed, the single bird femur identified [Point OBJ 1252] is likely to be part of a larger bird bone assemblage. One record is located within the rectangular stone hearth feature 1 in the Hearth excavation. Here a scatter of burnt bird bones [Point OBJ 1540] were found along with a variety of shellfish, obsidian, ochre and water rolled boulders. The final record is a single unidentified bird humerus found in the open settlement site R06-85 on the northern plateau. This is the only bird bone record to be located outside the southern lowlands. All the bird bone recovered appears robust which suggests accelerated taphonomic decay processes due to soil PH has not occurred.

Discussion

Modern naturally occurring bird bone is mostly associated with shearwaters such as *P. bulleri* (Buller Shearwater). The author has seen recently deceased Buller Shearwaters in many localities around the island, and although some may be due to predation by the local Harrier Hawk population, most appear to be from accidents that occur during night landings following feeding at sea. However the bird bone recorded in the GIS are cultural rather than natural deposits, as can be seen by the evidence of burning on the bone and their association with a range of portable material culture associated with cooking and rubbish disposal. The fact that only two of the seven bird records can be identified to a shearwater bird species is noteworthy considering the current Buller Shearwater population of 500,000 and to the importance traditional accounts give to 'mutton-bird' collecting of the Buller Shearwater young (rako) on these islands. However it must be remembered that mutton-birding activities will not leave easily recognisable modifications in the archaeological record since no structural modification to stone or earthwork are required to retrieve the birds, and because the cooking, potting and preserving (in gourds) process – assuming it occurred on the island rather than back on the mainland - may have involved the whole bird and so again no faunal material would be left behind to appear in the archaeological record. Further research is needed on (i) ethnographically recorded activities to determine how archaeologists should be looking to identify mutton-birding in these island landscapes, (ii) and on experimental studies on bone survival in different soil types to determine if accelerated taphonomic decay is an issue or not in their absence from the archaeological record.

Mammal

A total of six mammal bones were recovered from the island's faunal assemblage. These consisted of four dogs, two pig and one seal bone. Three of the four dog bones are situated in the southern lowlands, with one unidentified bone fragment associated with the specialist Carver site R06-27 being found in a midden area along with shellfish and fishbone [Point OBJID 1306]. Hearth site R06-24 contains the second of these in the form of a burnt metatarsal identified as either dog or seal just outside the open side of the stone hearth 1 feature along with shell fish, fishbone, obsidian and the local rhyolitic rock [Point OBJID 506]. The third is an isolated (possible) tibia fragment found on the surface on the trail leading up the escarpment at R06-20 [Point OBJID 98]. The fourth dog bone [Point OBJID 152] is found up on the northern plateau on the slope north of R06-14 that leads down to the north-west Buller Stream. Here it is found less than 20 m east from the one fur seal lumbar vertebrae [Point OBJ 153] as well as from some obsidian and shellfish. The final two bones are fragment of a single pig mandible found on the surface of the cave floor (R06-17). This has been split lengthwise, has one remaining molar and is covered with ash from the cave floor, but does not of itself appear to be burnt [Point OBJID 1101 & 1784].

Discussion

Three fur seal were spotted basking on rocks below the cave site (R06-17) in 2005 and so it is not unexpected that they were also present in prehistory and that the seal bone found in an archaeological context [point OBJID 153] is present as a result of hunting by island based Māori. However by the time of European arrival seal were in very limited supply with no breeding colonies remaining extant on the Northland mainland (Smith, 1985; 2005). As such this single bone may represent an opportunistic capture of an individual seal [MNI = 1].

The Polynesian dog (kuri) was brought by the first Polynesian settlers to New Zealand and was used for food while the bone, skin and teeth were valuable raw materials (Davidson, 1984:74, 80 & 92). It is not uncommon to find kuri bone in prehistoric excavations, and so finding four isolated dog bones amongst pre-European material culture confirms their presence on this island during prehistory. Evidence of dog gnawing on human bone (discussed in section 5.4) hints that kuri presence on the island continued up to and possibly after the massacre of 1823. Although an MNI for dog is only one, the fact that two bones were found in sites R06-14 & 17 located 3km apart suggests that MNI should be two.

The presence of two fragments of pig mandible is a strong indication for occupation on the island after 1769, since the pig was only introduced to New Zealand after European arrival (see Chapter 4). Historic and oral history accounts confirm that a domesticated pig population had been established on the adjacent Aorangi Island by the early 1800s. After people abandoned Aorangi in 1823, pig populations survived, became feral and continued to flourish on that island up until their final eradication in 1936 (Yerex, 1936). Documented evidence about these pigs explicitly states that there were no such feral pig populations on Tawhiti Rahi (Bollons, 1922; Yerex, 1936) therefore the pig bone found in the cave (R06-17) on Tawhiti Rahi Island most likely represents an imported item presumably for consumption that was deposited sometime between 1769 and 1823 [MNI = 1]. The significance of using historic pig bone as constraints in a Bayesian age/depth model allows the radiocarbon calendar date range for the pollen core to be tightened up (Dillingham, Appendix 8i). This is discussed in detail in Chapter 4.

Reptile A

minimum number of three tuatara were found from 11 elements dispersed through four midden areas within site R06-27. Considering the large population of Tuatara currently present on the island, it is interesting that their bones are only found in this one site and are not burnt. This hints that their presence here is a result of natural rather than cultural processes.

5.3.2.2 Shellfish

Using comparative photograph records (Morley, 2004), shellfish recorded on Tawhiti Rahi Island were identified and entered into the GIS database as portable material culture point data (Figure 5.60; Table 5.40 & 5.41). Most of these objects have been physically collected, however a small number were recorded but not collected from previous archaeological surveys. For each of these historic records a MNI of one was entered however no weight data was entered. All the shell objects have been divided into four habitat locations defined as rocky shore, sandy shore, terrestrial and unknown. The 'unknown' reflects actively collected material where a weight is given but no MNI can be assigned since no species can be identified. In total 191 shell objects have been identified in 19 archaeological contexts on Tawhiti Rahi Island

1. Rocky shore:

Eight taxa of rocky shore shellfish have been identified with a total of 102 samples recorded (Plate 5.39 and 5.40). This assemblage is dominated by 36 Whelk (*Dicathais orbuta*) and 23 Cooks turban (*Cookia sulcata*) and to a lesser extent by 16 Barnacle (*Balanomorpha*). All the shellfish could potentially be sourced to the marine environment immediately around Tawhiti Rahi Island. They were found throughout the island in equal numbers, with 21 samples in five sites on the northern plateau, 42 samples in five sites in the southern lowlands and nine in the cave site (R06-17).

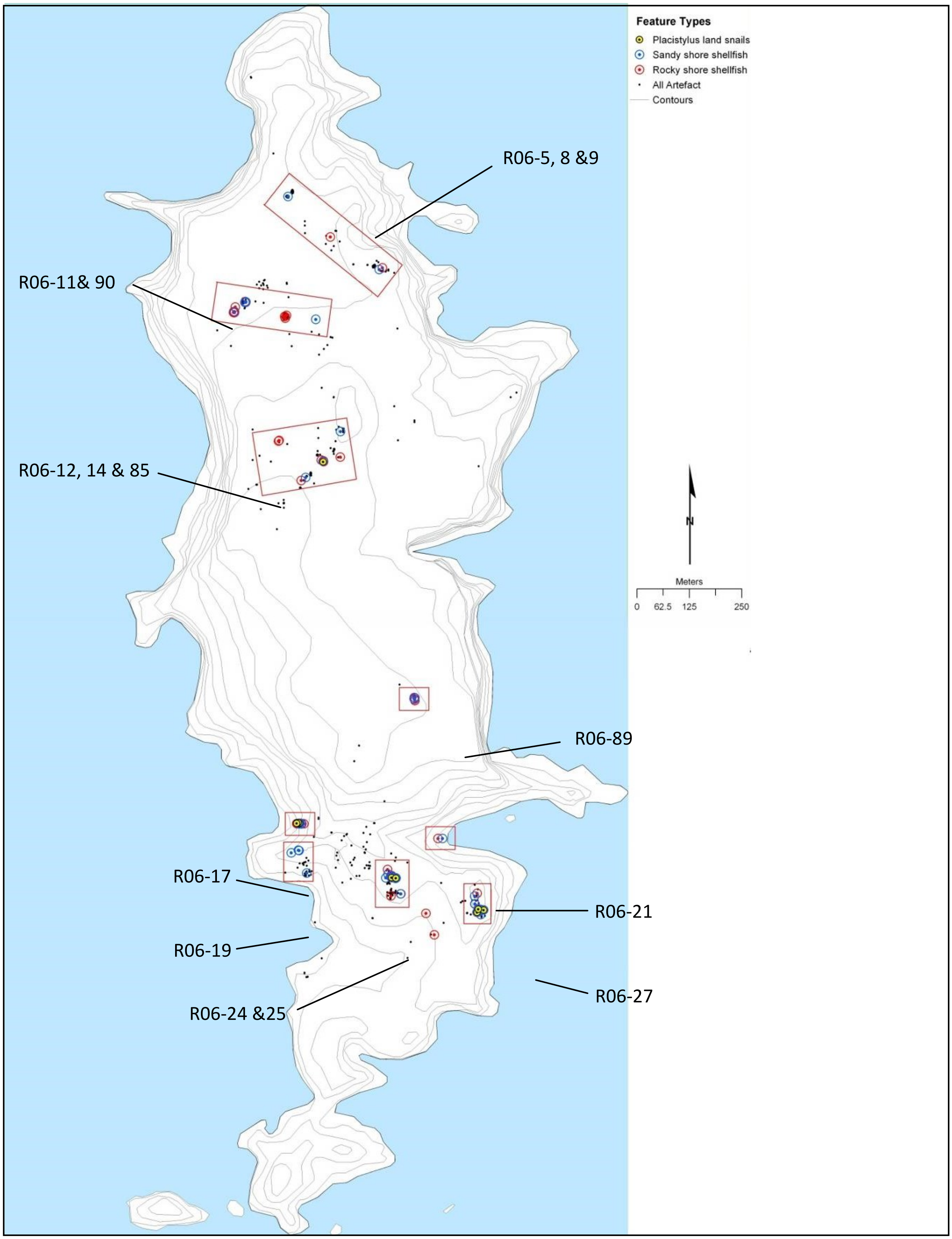


Figure 5.60 Tawhiti Rahi Island distribution of sea and land based shellfish in recorded archaeological sites. Red squares show areas discussed in the text

Table 5.40 Faunal shellfish

Description	MNI collected	MNI historic	Total MNI		Total Collected Weight
Rocky shore habitat 81 locations					
Balanomorpha (Barnacle)	16		16		33.46
Cellana denticulata (Dentate limpit)	8		8		16.03
Charonia lampas (Trumpet/conch)	3	1	4		59.74
Cookia sulcata (Cooks turban)	11	12	23		33.74
Dicathais orbuta (Whelk)	32	4	36		285.55
Nerita atramentosa (Bubu/Pupu)	8	4	12		14
Perna canaliculus (Green lipped mussel)	1		1		3.06
Saccostrea cucullata (Oyster)	1	1	2		1.19
Sandy shore habitat 50 locations					
Austrovenus stutchburyi (cockle)	2		2		2.05
Paphies australis (pipi)	39	6	45		91.74
Paphies subtriangulata (tuatua)	8	2	10		24.64
Pecten Novaezelandiae (scallop)	1		1		7.14
Unknown habitat 11 locations					
Unidentified shell	9	3	12		10.42
Terrestrial locations					
Land snail – *Punctidae spp* (Kauri snail)	1		1		0.29
Land snail – *Placistylus hongii* (Flax snail)	18		18		60.79
TOTAL			**191**		**645.59**

Table 5.41 Faunal shellfish records by site

Sites	Sandy Shore	Rocky Shore	Land Snails	Unknown	TOTAL
R06-5	1				1
R06-8		1			1
R06-9	1	2		1	4
R06-11	3	9	1		12
R06-12	1				1
R06-14		2			2
R06-17	5	9	12	5	31
R06-19	4				4
R06-21	1	1			2
R06-24	18	21	2	2	43
R06-25	1	2			3
R06-26		1			1
R06-27	10	16	3	3	32
R06-28		1			1
R06-85	2	5	1	1	9
R06-89	2	2			4
R06-90	1				1
	50	72	19	12	152

Plate 5.39 Rocky shore shell species (1of2) identified on Tawhiti Rahi Island and entered into the GIS. [Robinson 2013 DSC_0007]

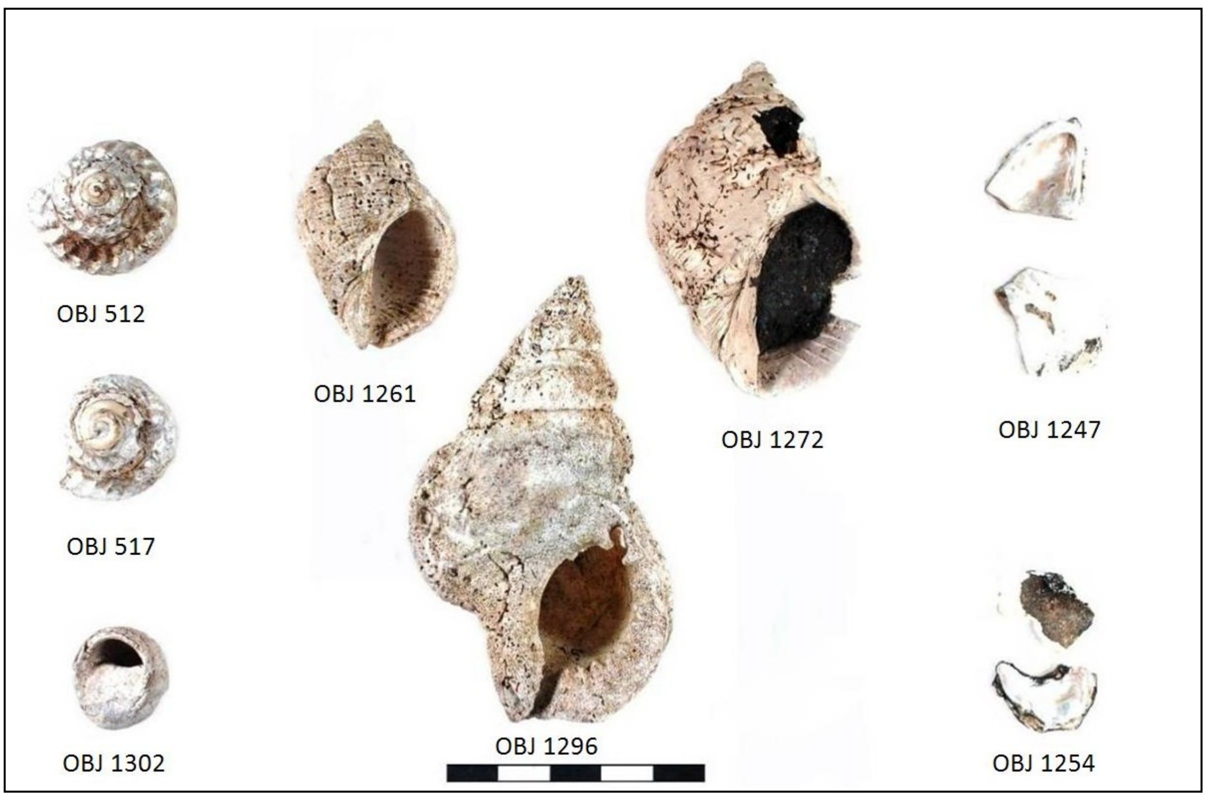


Plate 5.40 Rocky shore shell species (2 of 2) identified on Tawhiti Rahi Island and entered into the GIS. [Robinson 2013DSC_0004]

2. Sandy shore:

Sandy shore: Four taxa of sandy shore shellfish have been identified out of a total of 58 samples recorded (Plate 5.41). This assemblage is dominated by 39 pipi (*Paphies australis*) and to a much lesser extent by eight tuatua (*Paphies subtriangulata*), along with two cockles (*Austrovenus stutchburyi*) and one scallop (*Pecten Novaezelandiae*). These shellfish were found throughout the island, but with a southern lowland bias. For example, eight samples in five sites were located on the northern plateau, while 34 samples in five sites were situated in the southern lowlands. A further five were found in the cave site (R06-17). All the shellfish come from sandy shore, estuary or harbour environments, none of which are found in the rocky shore marine environment around the entire Poor Knights Island group.

3. Terrestrial: Two species of land snails were identified within the precincts of archaeological sites (Plate 5.42). Similar in shell shape to the tiny (1-2 mm) *Punctidae* spp land snails commonly found on these islands, this first shell is an isolated example of land snail that is an as yet unidentified member of the kauri snail family (*Paryphanta spp*) (Doc, 2006). Despite this example being damaged, it measures a minimum of 2.4 cm in diameter. The second species is the flax snail (*Placistylus hongii*) and a total of 17 have been recovered from four separate archaeological sites (R06-17, 19, 24 and 27) located at the southern end of Tawhiti Rahi Island. Their distribution matches that of other shell midden and so appears to be associated with food preparation and cooking areas, but it is unclear whether there is a direct causal relationship in place. In other parts of the Pacific such as New Caledonia, similar land snails are traditionally eaten however there is no ethnographic evidence supports their consumption in New Zealand. Hayward and Brook (1981) argued from broken and burnt samples of Placistylus hongii flax snail found in Cave site R06-17, that just such consumption did occur on Tawhiti Rahi Island in prehistoric times.

Discussion

Very few of the collected marine shell show the grey colour indicative of being heated in fire, however all the rocky and sandy shore environment shellfish are edible and presumably this is the primary reason for their collection. Other uses for shell once the flesh is eaten include flax scraping, cutting or, in the case of the four examples of trumpet/conch (*Charonia lampas*), for use as a trumpet. Although it was beyond the scope of this research to carry out formal use ware analysis, all samples

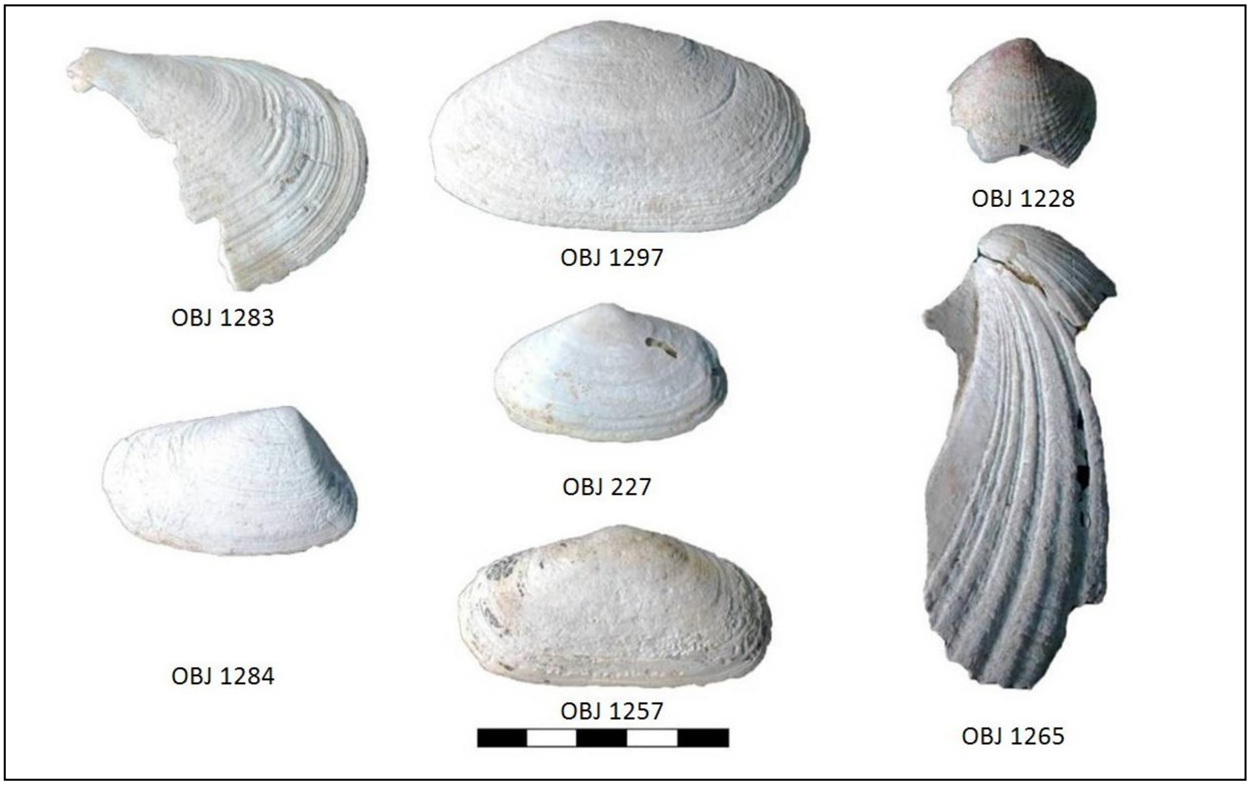


Plate 5.41 Sandy shore shell species identified on Tawhiti Rahi Island and entered into the GIS. [Robinson2013 DSC_0024]

Plate 5.42 Terrestrial land snail shell species from Tawhiti Rahi Island and entered into the GIS. The Kauri snail Paryphanta spp left [Point OBJ 1245], and the flax snail Placistylus hongii right [Point OBJ 1238]. [Robinson 2013 DSC_0011]

were handled and cleaned and no clear evidence of use wear or structural modifications was observed on the shell.

Using the 'presence – absence scenario' mentioned elsewhere in this thesis, the key issue here is that while rocky shore species could be local or imported, the tuatua, pipi, cockle and scallop that make up the sandy shore shell fish assemblage from Tawhiti Rahi Island must be imported as the Poor Knights Islands only has rocky shore environments. The nearest harbour, beach and estuary environments where such shell fish could have been brought from include Great Barrier Island 60km to the south-east and/or the Northland Mainland that is 25-60 km to the west (distance varies depending on the harbour or estuary chosen).

Examination of the GIS generated Figures 5.77 & 5.78 identifies two interesting patterns of shell fish and fishbone distribution within the southern lowlands. First, the dispersed settlement immediately west of Hearth site R06-24 shows no evidence of fish or shellfish consumption, but does show a distribution of obsidian. This lack of any faunal material suggests that the smaller terrace sites in the dispersed settlement were only focused on lithic activities. The second of these patterns occurs around the specialist canoe landing site R06-19 which only shows evidence of isolated sandy shore shell fish not found in a midden or cooking area. This might be interpreted in a number of ways including that: (i) this site is the location where sandy shore shell fish were landed on the island from canoes that were stored at this location (see Ch 5 Section I for a detailed discussion of this site), or that (ii) the lack of any rocky shore shell fish here suggests that their procurement did not require the use of canoe transport – and therefore was a local resource, and that (iii) the lack of any fishbone or evidence of cooking at the specialist canoe haul out area suggests that food preparation occurred elsewhere in habitation areas.

Looking at the terrestrial snails, the kauri snail example does not appear in the literature and so is likely to be one of a large number of endemic land snails not yet identified from the Poor Knights Group. The flax snail (*Placistylus hongii*) however is much more common, being found in many locations around the New Zealand mainland and on offshore islands. Due to flax snails being a very plastic genus, isolated communities of Placistylus have undergone extensive sub speciation in New Zealand. It is a surprise then that hongii species occurring on the Poor Knights are not distinct from those found on the mainland (Climo, 1971:68).

Since the Poor Knights Islands and the adjacent Whangaruru harbour both contain rare albino species of flax snail, it is presumed that this snail was not endemic to the Poor Knights Islands, but rather was introduced by Māori to these islands from these mainland colonies at some point in prehistory (Powell, 1938; Climo, 1971:68). An alternative hypothesis is that they were endemic and their presence around Whangaruru harbour reflects an introduction the other way, from the islands to the mainland (Brook pers. Comm, 2003). Which-ever way this occurred, this clearly shows human agency in the communication between the Poor Knights Islands and Whangaruru Harbour on the adjacent Northland mainland coast, sometime within the last 700 years.

5.3.3 Floral material

An assemblage of 82 floral records has been recorded on Tawhiti Rahi Island, and their distribution has a strong bias to the southern lowlands (R06-17, 22, 24 & 27), and the south-western cave site R06-17, with only two records being located on the northern plateau at open site R06-11. However this bias may be more perceived than real since there has been limited sampling and excavation in the areas north of Puketuaho Hill (R06-12). Within the southern lowlands the cave site R06-17 has 65 records, dispersed settlement sites R06-22 and R06-24 have one and 13 records respectively, and the specialist carver site R06-27 has one record. The dominance of floral material in cave site R06-17 and to a much lesser extent the hearth site R06-24 is not due to their excavation, since few floral records were found subsurface. Instead this dominance appears to be real and reflects the visible surface distribution of floral material over the whole island.

The 82 records divide into burnt (51) and un-burnt material (31). The un-burnt includes wood (21), fiber (4), seeds (2) and unidentified (4) while the burnt is solely charcoal (51). In terms of cultural values that can inform our understanding of this island's human settlement, the floral material can be divided into made artefacts (7), by-products of cultural action (5) and cultigens (1). The charcoal and some of the wood found on the floor of the cave is indirectly cultural as they are all found in archaeological contexts associated with man-made fires but they lack any obvious modification beyond their species type. These cultural categories will now be discussed under the headings of Artefacts, By-products of cultural action, Gourd seeds and Charcoal and wood.

1. Artefacts:

A total of three wooden artefacts were identified on Tawhiti Rahi Island. The first of these is the canoe plankfound on the citadel (R06-18) in association with the crevice burial of a mature male [Point OBJ 110]. Apparently made from totara, it measures approximately 1 m long by 10-20 cm wide and has a series of binding holes drilled through one edge of the plank. Māori burials associated with similar panels occur often enough in New Zealand for them to be generally referred to as 'canoe' burials. The second wooden artefact is a small 30 cm long fragment of a wooden tool [Point OBJ 1208] (Plate 5.43). Recovered from the surface of the cave floor, this artefact has clearly been shaped with an adze and at least half of the butt end is still visible, but an unknown amount of the head end and part of one side has been removed presumably through functional use. Post breakage damage is visible where some individual has made four perpendicular stone adze or metal axe cut marks on the wood. The function of this tool is unclear but might have been part of a weeding implement.

The third and final wooden artefact was found deliberately cached on a flat rock under a larger sheltering rock that leans against the steep slope. Located 18 m south of the lowest terrace of dispersed terrace site R06-22, this object takes the form of a carved panel of totara wood measuring 80 x 26 cm and is 4-6 cm thick [Point OBJ 118] (Plate 5.44). On the anterior side there is a band of complex spirals 8 cm in width extending from the proximal end for nearly the whole length of the board, before ending at a partially damaged carved figure that may have lost

Plate 5.43 Rock shelter site R06-17, small unidentified wooden tool fragment.[Point OBJ1208] [Robinson2014 IMG_8768]

Plate 5.44 Carved panel from building previously found in a cache on Tawhiti Rahi Island [Point OBJ 118]. The taonga (treasure) is held by(from right to left); Tohunga Whakairo Te Warihi Hetaraka (Ngatiwai), Kaumatua Phillip Hetaraka (Ngatiwai, Te Uri o Hikihiki, Rangatira Hōri Parata (Ngatiwai, Ngati Korora) and Ngatiwai Trust board member live tone. [Robinson 2008]

its head. The spiral design is incised but does not extend completely through the board, and remnants of whitepaint are visible in the deeper incisions. The carved figure at the proximal end follows the well known Māori carving design involving short legs, a 'three fingered' hand and the carving of this does extend through the board and is the only carved section to continue around the edge of the board to the posterior side. Two irregular and rounded holes are visible extending through the board at the proximal end, and one square section hole has been cut into the posterior side. This square hole extends 3 cm into the wood but does not cut completely through the board. Adjacent to this is some apparent breakage to the board, possible involving another square section hole. This may be part of the same destructive process that resulted in the partial loss of the carved figures head.

Discussion

This carved panel artefact was examined in the field by Te Warihi Hetaraka - a Whakairo Tohunga – a title that refers to a master carver with additional responsibilities for spiritual as well as physical aspects of carving. Te Warihi Hetaraka has carved numerous traditional buildings and is highly respected both nationally and internationally. He identified that this object followed the Ngatiwai style of carving, that it was not a canoe panel as shown by the spiral motif being designed to be seen from only one side, and from the design elements neither was it part of a carved food store (Pataka). Instead he identified it as the end panel from the carved barge board (Raparapa) of an important building – probably a chief's residence or whare hui (meeting house). The two irregular holes at the proximal end were for lashing it to the next panel higher up the lintel. The square socket was for attachment to the building itself. The figure with three fingers at the end of the panel is designed to be seen from the front and sides and so its design elements curve around the end of the board. Te Warihi Hetaraka's father was also a Whakairo Tohunga who worked with metal tools but retained knowledge associated with the manufacture, maintenance and use of stone tools for wood carving. Sharing his father's knowledge, Te Warihi noted that the tools used to carve the spirals have left distinctive marks that show them to have been made of stone. Tellingly, he also noted that the square section attachment hole on the posterior side was made with metal tools.

These three wooden artefacts are all made from imported totara that was shaped using stone tools, which dates their construction to somewhere in the prehistoric period. The metal tool carved attachment socket on the carved panel [Point OBJID 118] suggests that while the carving of this panel may predate European arrival in New Zealand, the use and subsequent modification of this artefact continued into the early historic period when metal tools were rapidly adopted by Māori. This panel along with the two fragments of pig mandible in the cave are the only examples of portable material culture that date the ongoing settlement of this island into the earlyhistoricperiod. The finding of other carved wooden objects on the adjacent Aorangi Island goes back to the 1920s and was reported by Bollons and Fraser (History Chapter 3) and some of these artefacts are curated in the Auckland Museum (Robinson, 2004: see front cover pencil drawing). Howeverthis panel from Tawhiti Rahi Island is the first evidence that a high status carved building existed somewhere on the Poor Knights Islands. The discovery of this panel suggests that Māori settlement was large scale and probably involved the presence of a chief. The first and only chief known to have lived on this island was Te Tatua who in 1823 was old enough to be the father of a young son. Therefore his residence on this island is unlikely to start any earlier than 1790 and finished in December 1823 following an inter-tribal attack (See Chapter 3 history section).

2. By-products of cultural action:

A total of eleven chips of wood were recorded from the cave site R06-17 and entered into the GIS. Two were located on the cave floor surface, while the remaining nine were all found in spits 1-4 of Test Pit 1. Of these eleven, the two surface chips and four of the test pit chips showed evidence that they had been produced by adzing of wood. The remaining five showed no clear evidence of adzing. These adzed flakes are found from the surface to 19 cm deep in the test pit and were found in association with charcoal, with fiber that might once have been matting and with introduced cultigens in the form of gourd seeds.

The matted fiber material is extremely decayed. It is found in four places in the cave, both on the surface and in spits 2 and 4 of Test Pit 1 [Point OBJID 1509, 1548, 1560 & 1570]. It also has a general association with charcoal and wood chips as discussed above. It has not been possible to identify conclusively what this material is but the working hypothesis is that it is decayed flax with only the stronger fibers surviving. There are multiple potential uses for flax fibers, including woven mats, flax kits and cordage. At this stage it is unclear if these degraded samples reflect unprocessed decayed flax leaves or are remnants of made items such as floor mats. What is clear is that the flax was deliberately brought into the cave.

Discussion

Together these fibers and wood chips that are by-products of cultural activity, suggest that a complex range of subsistence and living activities were occurring in this cave. Dates for this cave occupation are discussed in detail in Chapter 5 Section II.

3 Gourd seeds:

A cluster of at least 8 gourd seeds were recovered from the cave site R06-17 from spit 4 (14-19 cm) in Test Pit 1 and one from the surface collection [Point OBJID 1585 & 1726]. The best preserved of these were photographed (Plate 5.45). These were identified by Dr Andrew Clarke as being mature gourd seeds, but due to degrees of decay he could not determine from the shape whether they were of South American or South-East Asian origin. Since only immature gourd was eaten, these mature seeds were most likely associated with planting and cultivation practices. Due to the low in built age associated with seeds, these were sent off to ANTSO in Australia for AMS dating. Results suggest that their calendar age ranges from 330-490 BP (median 1553 AD) (Appendix 8:ii & iii). These and other dates are discussed in more detail in Chapter 5 Section II.

Discussion

Mature gourd seeds provide the first concrete evidence about the types of cultigens being grown on Tawhiti Rahi Island by Māori.

Plate 5.45 Rock shelter site R06-17:Mature Lagenaria siceraria (hue - bottle gourd) seeds recovered from Test pit 1 [Point OBJID 1585]. Calibrated and modelled AMS radiocarbon assessments from the ANSTO laboratory in Australia, give a calendar date range of 320-480 BP. [Robinson 2011]

4 Charcoal and wood:

Of the 51 charcoal records and 13 wood records in the GIS, nearly all are located in the cave site R06-17. Out of these a total of 21 charcoal and 13 wood samples were sent to the charcoal and wood identification laboratory located in the Department of Anthropology and Archaeology at the

University of Otago. Here Dr Yanbin Deng undertook thin section analysis and comparison with reference specimen and from this she identified 29 of the 34 samples. These results along with information on traditional Māori usage collated from a Māori plant use database (Landcare Research 2014) were placed into a table (Table 5.42).

The data in Table 5.42 shows a wide range of identified tree species. All were types that could be found in Northland, and despite the limited botanical range of species currently present on the Poor Knights Islands, none could be definitively confirmed as having been imported. Interestingly, there is no overlap between those species identified from wood and those identified from charcoal. Most of the tree species had multiple traditional uses with medicine being a dominant group. Only some individual species such patee (*Schefflera digitata*) that are associated with fire starting, and Maakaka (*Plagianthus divaricatus*)or hohere (*Hoheria Glabatra*) that are used to make belts, mats and hair fillets, might be associated with occupation activity in the cave beyond being just firewood (Landcare Research NZ web site 2014).

5.3.4 Summary of Part III

The analysis of the lithic, floral and faunal material recovered from the survey [5.1] and excavation [5.2] confirm that the last period of Māori occupation on Tawhiti Rahi Island, and probably all of the Poor Knights Islands was a permanent settlement, making use of both local resources (such as fish) and also accessing certain exotic shellfish and lithics unavailable on these islands. The procurement zones for these items appear constrained by social, environmental and political considerations to a regional area that is bounded by the east coast of Northland from Whangārei in the south to Whangaruru Harbour in the north and east out over the sheltered waters to Great Barrier Island.

Both the late design of adzes and the lack of significant Mayor Island obsidian are consistent with late rather than early prehistoric settlement. The presence of rare pig bone and one metal tool carved wooden panel indicate that this settlement continued into the early historic period. The lack of portable material culture directly associated with gardens and with mutton-birding means it is hard to directly engage with the specifics of what crops the islanders were growing or how important the harvesting of rako (muttonbirds) was to them.

Table 5.42 Floral wood and charcoal identification from Cave site R06-17.[Feature OBJID 2911]

OBJID	Site	Depth	Charc'l	Wood	No.	Taxa*	Name*	Traditional use*	
1486	RO6/17	Surface	●		1				
1494	RO6/17	Surface	●		1	*Aristotelia serrata*	Makomako	Medicine	
1473	RO6/17	Surface	●		1				
1488	RO6/17	Surface	●		9		tutu		Food
1496	RO6/17	Surface	●		2	*Coprosma spp.*	tutu	Medicine	Dye
1502	RO6/17	Surface	●		2		tutu		
1208	RO6/17	Surface		●	1	*Dacrydium cupressinum*	Rimu	Medicine	Food/dye
1012	RO6/17	Surface		●	1				Hard wood
1016	RO6/17	Surface		●	1	*Dodonaea viscosa*	Akeake	Medicine	Tools
1019	RO6/17	Surface		●	1				Weapons
1018	RO6/17	Surface		●	1				
1501	RO6/17	Surface	●		1	*Dysoxylum spectabile*	Kohekohe	Medicine	
1471	RO6/17	Surface	●		1				
1493	RO6/17	Surface	●		1	*Elaeocarpus dentatus*	Hinau	Medicine	Food/dye
1485	RO6/17	Surface	●		1	*Elaeocarpus hookerianus*	Pookaka	Medicine	Dye
1487	RO6/17	Surface	●		2	*Fuchsia excorticata*	Kotukutuku		Food
1495	RO6/17	Surface	●		3				Dye
1472	RO6/17	Surface	●			*Hoheria populnea*	Houhere	Medicine	Food, fiber Adze polish
1013	RO6/17	Surface		●	1	*Knightia excelsa*	Rewarewa	Medicine	Food
1500	RO6/17	3-5 cm	●		1	*Leptospermum scoparium*	Manuka	Medicine	Food
1483	RO6/17	Surface	●		1	*Lophomyrtus bullata*	Ramarama	Medicine	Food
1491	RO6/17	Surface	●		1				Adze helves
1014	RO6/17	Surface		●	1	*Melicope ternata*	Whaarangi	Medicine	
1470	RO6/17	10-40 cm		●	1	*Metrosideros umbellata*	Southern rata	Medicine	Hardwood tools/ weapons
1498	RO6/17	Surface	●		1	*Neomyrtus pedunculata*	Roohutu	Medicine	Food
1510	RO6/17	9 cm		●	1	*Nestegis cunninghamii*	Maire		Hardwood tools/weap'
1017	RO6/17	Surface		●	1	Not identifiable			
1026	RO6/17	Surface		●	1	Not identifiable			
1027	RO6/17	Surface		●	1	Not identifiable			
1015	RO6/17	Surface		●	1	Not identifiable			
1484	RO6/17	Surface	●		6				Hair fillets
1492	RO6/17	Surface	●		1	*Plagianthus divaricatus or Hoheria labatra*	Maakaka or Houhere	Fiber	Belts
1503	RO6/17	Surface	●		3				Mats
1497	RO6/17	Surface	●		2	*Schefflera digitata*	Patee	Medicine	Dye/Fire

***** *Landcare Research NZ. Manaaki Whenua – Māori plant use database.*

5.4 Part IV: Koiwi (Human remains)

Encountering koiwi (human remains) on Tawhiti Rahi Island during this research was always a strong possibility. In part this is because of the well documented attack in 1823 on the Poor Knights, but also because visitors over the last 50 years had noted some earlier rock shelter burials on both Aorangi and Tawhiti Rahi Islands that date back to when the islands were inhabited (see Chapter 3 for a detailed discussion on the islands history). After discussions with the Ngatiwai Trust Board and with senior Rangatira and Tohunga, it was agreed that these remains were an essential part of the island's history that needed to be told but at the same time tika (appropriate respect) was essential. To ensure that this occurred, the following protocols were written up to guide us in this research.

- All koiwi encountered during the survey were identified, located and photographed. This information is to be lodged with the Ngatiwai Trust Board.
- Any koiwi encountered during excavation would result in excavation ceasing after confirmation of their human status. Photographs and location data of the koiwi was to be made for transmission to the Ngatiwai Trust board and the excavations backfilled.
- Previously identified koiwi would be located and confirmed but not touched. Photographs and location data of the koiwi were to be made for transmission to the Ngatiwai Trust board.

Results

The survey and subsequent excavation identified seven records of human bone located in four sites (Table 5.43). One record of a single tibia was found on the surface of habitation site R06-9 located on the north side of the northern valley [Point OBJID 275]. One record of a burial with one confirmed adult crania bone was found at the high point of Wananga site R06-12 known as Puketuaho Hill [Point OBJID 1683]. It is likely that this is just the exposed part of a complete crouch burial with multiple bone components, but following protocols, this was not investigated. A different form of burial was found at the top of the Citadel Hill R06-19, where seven disarticulated bones from one adult [Point OBJID 110] had been placed in a rock cleft near to a totara plank from a canoe [Point OBJID 1695]. The remaining four bones were found scattered over a 40 m wide area on the south-west side of the Carver site R06-27, and include a complete mandible, an isolated tooth, a right tibia and a vertebra [Point OBJ 45, 55, 57 & 1682].

Table 5.43 Human remains.

OBJ ID	Class	No.	Type	Description	MNI	Location
275	Human bone	Single	Find	1 x Tibia long bone - adult Surface	1	R06-09
110	Human Bone	Multiple	burial	Rock overhang. Burial with canoe plank	1	R06-19
45	Human Bone	Single	Find	1 x Tibia (R) long bone. Surface		R06-27
55	Human Bone	Single	Find	1 x tooth (molar). Surface		R06-27
57	Human Bone	Single	Find	1 x vertebrae Surface	1	R06-27
1682	Human Bone	Single	Find	1 x mandible - adult. Surface Rocker jaw. Fern root plane on teeth		R06-27
1683	Human Bone	Multiple	burial	Cranium partly exposed. 20 cm	1	R06-12
TOTAL					**4**	

Discussion

The human bone identified was deposited through two different processes. Assuming that the cranium found at Puketuaho Hill is part of a complete body, then it and the disarticulated skeleton found in a cleft at the top of Citadel Hill are representative of formal burials (Urupa) placed here by the community that lived on the islands at some time *prior* to the islands abandonment in 1823. This type of crouch burial and bone cache are well documented in the ethnographic literature in New Zealand and are encountered relatively often in some types of prehistoric excavations. These areas would have had a strong tapu status and would have been clearly separated from everyday activities occurring elsewhere on the island. In contrast, the surface deposits of a single bone at the habitation site in the north (R06-9) and the scatter of single bones found at the specialist Carver Site in the south (R06-27) is something very different. The surface distribution of human skeletal material in and around sites that were clearly in use at the time the island was abandoned is best explained as islanders killed by the Te Hikutu war party who attached these islands in 1823 (see Chapter 3). These two individuals only being represented by occasional body parts may explain why they were apparently missed by Chief Te Tatua when he collecting the dead prior to their repatriation to the mainland for burial. The wide distribution of individual bone from what is probably one individual at the Carver site R06-27 may reflect post attack foraging by dogs. This is supported by the distal and proximal damage to the tibia [Point OBJID 275] that is probably consistent with gnawing by dogs when the bone must still have had some nutritionasl value (Taylor, 2005 pers. comm. to Ivan Bruce, 2016) presumably abandoned on the island after the attackers left.

5.4.1 Summary of Part IV

If this interpretation of the human skeletal material is correct, then the crouch and cleft burial reflect ceremonial processes involving burial of the dead and are also a statement of land ownership by the island inhabitants at an unknown time period prior to 1823. The scatter of human bone identified on the ground surface is not consistent with our understanding of prehistoric or contemporary Māori mortuary practice rather it reflects human fatalities resulting from the attack by outside parties that occurred in December 1823.As was discussed in Chapter 3, Chief Te Tatua subsequently repatriated the dead to Roimata Pt at Whananaki on the Northland coast. It is assumed that the individual bones encountered during this research were not seen and therefore missed being uplifted by Te Tatua.

5.5 Conclusion

A general discussion will now be made that synthesizes the results of this archaeological research. Major strands of evidence from the survey, excavations and portable material culture will be woven together to produce a dialogue that engages in a general way with the thesis questions about who settled these islands, why did they come here and when did this happen? This will be followed by a final summary section that briefly sets out what archaeology can and can't say about these three questions.

Discussion

The survey of the archaeological surface features on Tawhiti Rahi identified a complex of stone and earth features constructed on volcanic soils. These are similar to constructed landscapes recorded elsewhere in northern part of the North Island such as at Pouerua in the inland Bay of Islands, Waipoua on the west coast and the extensive stone fields of the Auckland region and are clearly of Māori origin. The design of these landscapes is limited to the temperate north of New Zealand and cannot be attributed to any particular iwi or hapu. The core of this settlement activity focused on seven gardens that were established in sheltered areas mostly around shallow river valleys. In addition four large and eight small habitation areas are located on the slightly raised and well drained ridge tops and cliff tops found over most of the island. A range of specialist areas associated with food storage, lithic work floors and landing sites and ceremonial areas associated with urupa (burial sites) with interned bodies in at least two places implies that this horticultural settlement was substantial and permanent.

A series of excavations were made that show at least some of the terrace clusters are habitation sites in that they contain the full panoply o f domestic functions such as midden, cooking, tool working and built structures. What is interesting is that there are implications of some relative time depth. For example occupation at the Hearth site (R06-24) occurred for long enough for the inhabitants to excavate, use and then infill a food storage pit. This is further supported by the test pit 1 excavation in the Cave site (R06-17) that revealed an intact stratigraphy showing three cultural horizons that represented two phases of occupation. Phase 1 is the earliest phase of occupation and at 20 cm deep was separated from the more recent occupation by a sterile white ash layer. This buried cultural horizon contained only a small amount of cultural material that included 10+ gourd seeds, some of which have been AMS C14 dated to 1550AD. It is significant that these seeds are mature, which means they were taken from gourds that were no longer edible. This suggests that they were most likely associated with seed stock for horticulture rather than for direct consumption. The phase 2 occupation includes material on the surface and other layers down to 10 cm deep and contains 99% of the cultural material recovered from this cave. The surface component of the cave is covered with a 2-5 cm thick layer of charcoal, fishbone, shell, obsidian and wood as well as structural alignments and fireplaces that have been dated to the very early historic period by the presence of both stone adzed wood and of European pig bone. Along with the known abandonment date for the island as a whole, this suggests the last period of occupation in the cave occurred between 1805 and 1823.

Despite the extensive bio-turbation of the island's archaeological stratigraphy by burrowing seabirds that has destroyed buried cultural horizons in the Hearth site (R06-24), the evidence found in the Cave site (R06-17) suggests that there were two discrete periods of occupation with an early period associated with gardening and later a more intensive period associated with habitation and gardening. Applying this picture conservatively to the wider island, the early period must have been underway by at least 1550AD when it most likely was focused on the southern end of the island south of the tableland plateau, where the only permanent water supply was located at Charles Stream and where the only reliable landing site was situated (R06-29).

It is likely that most, if not all, of the archaeological landscape visible today relates to the later period of occupation. This was underway by (at least) late prehistoric/early historic times and is associated with gardening and habitation. The southern end of the island remained important because of its monopoly on reliable access and guaranteed year round water supply, but now the extensive northern tableland plateau was fully utilised and a patchwork of garden and habitation sites constructed as was seen in two garden excavations at site R06-11. At the same time structurally unique ceremonial sites appear in the north and south of the island. Some of these are definitely associated with burial practices and possibly reflect the demarcation of 'tapu' and 'noa' zones. It is in this later period that habitation sites such as the Hearth site (R06-24) and specialist sites such as the Carver site (R06-27) and the canoe haul out site (R06-19 lower terrace) were definitely occupied.

This assumption of limited early use and extensive later use is supported by the artefact analysis that identifies only late period Māori adzes and a lack of any significant deposits of Mayor Island obsidian that are universally found in other early sites. Most importantly the dominant artifact recovered from the island – namely obsidian – seems to be nearly all from one unknown source within the mid-northern volcanic area that may be located on Great Barrier Island. Not only does this imply a late period development where regional sources of obsidian replaced the earlier Mayor Island national source, but also hints that this later settlement is likely to have been a single event from one location because other high quality local obsidian available within the wider Ngatiwai rohe (territory) both from the mainland (Huruiki) and Great Barrier Island (Te Ahumata) are missing from the assemblage. The small amount of other lithic material that can be reliably sourced to Whangārei (namely Onerahi chert, Whangārei dolerite), Northland (Tangihua gabbro) and other islands (namely three flakes of Mokohinau Island obsidian) along with sandy shore shellfish (that must come from either the mainland or Great Barrier) suggests that once established the islanders maintained links to other communities within the rohe (territory) of Ngatiwai prior to European arrival. The presence of European introduced pig bone in the cave but no resident population of such pigs suggest links to Ngatiwai communities that did domesticate European pigs (such as on the Adjacent Aorangi Island or in the Bay of Islands) and that continued into the historic period. The presence of a wooden carved panel partially worked with European sourced metal tools and of cooked pig bone reflects material goods that were early adoptions into Māori culture. The lack of later arriving European goods such as ceramic or glass suggests that Māori settlement on Tawhiti Rahi ended relatively early in the historic period.

Summary

This archaeology chapter is the core of this doctoral research. In it the detailed mapping of archaeological structures and portable material culture across the island landscape has engaged directly and indirectly with the 'who', 'when' and 'why' questions associated with human occupation on Tawhiti Rahi. For the 'who' question, the structural record in the built material culture identified in the survey [5.1] confirms that the evidence of human settlement is Māori in origin with strong links to both Great Barrier Island, and various locals in the Northland mainland. It does not tell us who the inhabitants were and where they come from. The location of distinctly different patterns of archaeological features in the valleys and the ridges strongly implies a primary focus on gardening and answers the 'why' question but, however it remains unclear how important fishing and mutton-birding were to the inhabitants. Multiple strands of evidence engage with the 'when' question. Following the survey a series of excavations were carried out [5.2], the results of which confirm the presence of a full 'kit' of habitation, garden, specialist and ceremonial/burial areas. These indicate that by at least the last phase of occupation, this island supported a permanent and substantive Māori settlement. Analysis of the portable material culture on this island [5.3] identified an absence of archaic tool types, the dominance of locally sourced obsidian, the presence of radiocarbon dated hue seeds (bottle gourd) and the absence (with the exception of two pieces of pieces pig bone and one a house panel carved with metal tools) of European sourced material. From the archaeology alone there is a terminus post quem for island occupation that starts no later than 1550AD when an indigenous Māori culture had already emerged on the mainland, and a terminus ante quem for the end of this occupation that occurred no later than 1830 in the early historic period when inter-tribal conflict was still endemic, and before European material culture had made a significant impact on traditional Māori life.

The concluding Chapter 6 will bring together the results from the history, earth science and archaeology sections of this multidisciplinary study.

Chapter 6: Conclusion

6.0 Introduction

This research is set within a regional archaeological context of New Zealand prehistory. It is focused on a coastal area of Northland that is part of the territory of a long established Māori iwi (tribe) known today as Ngatiwai. Working within a framework of island archaeology it examines the role peripheral islands play within this region and explores concepts of circumscription, colonisation and degrees of connectedness that might have caused these places to have a different trajectory of settlement from more central places in Māori society. Specifically it makes an in depth study of Tawhiti Rahi Island in the Poor Knights island group.

This study used a multidisciplinary approach that utilised history, earth sciences and archaeological data and asked each of these the same three questions of who settled this island?, why did this happen?, and when did this occur? The results show that each discipline brought different strengths and weaknesses to the debate but all engaged with one or more of the questions. These same strengths and weaknesses meant that individual interpretations of events within each discipline sometimes produced scenarios that were inconsistent or contradictory when compared between disciplines.

Chapter 6 is set out in three parts. First the results of the three data sets are integrated and briefly synthesized. Secondly an island specific history of Tawhiti Rahi is presented that incorporates the key points raised by each of the three disciplines. Finally, using the synthesis, the series of presence and absence scenarios identified on this peripheral island are used to model the changing trajectory and nature of Māori settlement over time and space within the regional context of this eastern seaway.

6.1 Summary of the Data Sets

When the results of the historical, palynological and archaeological studies are set against our three questions of who settled these islands, why did it occur,and when did it happen, both agreements and contradictions in the evidence become apparent. With regard to who occupied the islands there is broad agreement. The history identifies Northland-based Ngatiwai as having manawhenua (rights) over these islands with the mainland hapu (sub tribes) Ngatitoki occupying Aorangi and Ngatiwai on

Tawhiti Rahi. Looking specifically at Tawhiti Rahi, the records identify Chief Te Tatua and his wife Te Oneho - whose marriage reflects connections between the Whangaruru and Takahiwai (Whangārei) - living on this island with at most 300-400 people. The palynological record gives only a very broad picture that confirms human activity on the island that, from its timing and nature, is consistent with Māori as opposed to European occupation. The archaeology similarly identifies the archaeological landscape of built features as Māori in origin. The lithic and faunal portable material culture study provides a more precise picture sourcing material predominantly to a local region that incorporates parts of the Northland coast, and the eastern seaway out to Aotea (Great Barrier Island) including the Mokohinau Islands.

The 'why' question has similar levels of agreement. Historical research specifies that the island was occupied, that cultigens were gardened and that the rako (Buller's shearwater) were seasonally harvested as mutton-birds. Due to intertribal conflict people migrated to this island as a refuge since the encircling vertical cliff topography made it a natural 'pa' (defensive site) that could protect the inhabitants from attackers. The palynology reconstructed a vegetation history of the island from the pollen record. This identified a fundamental and dramatic shift from mature forest in a mostly fire-free environment to one dominated by only first succession species where fire was common and regularly occurred. Although direct pollen evidence of specific crops cannot be identified in the New Zealand environment, the pollen and charcoal record in this temperate climate and on rhyolitic volcanic soils with induced fertility from guano, is entirely consistent with the presence of fire-based Māori cultivation practices. The islands archaeological features are dominated by stone and earthwork structures that other studies have confirmed are associated with Māori gardening in the horticultural north of New Zealand. Excavated mature hue (bottle gourd) seeds explicitly identifies that this introduced plant was being cultivated here. The design of the garden features, along with remnant rectangular food storage pits, provide proxy evidence that kumara (sweet potato) was being cultivated on the island. The lack of archaeological data for mutton-birding is not necessarily indicative of non-use since this may just reflect a lack of waste material left by the processing methods. Similarly, the lack of defensive structures in the island landscape probably reflects the presence of naturally occurring cliff defenses that make built defenses redundant. Numerous habitation sites show that people were living in multiple places on the island and the presence of a range of specialist sites and ceremonial sites with burials, imply that a large, complex and permanent island-based settlement was in existence on the island late in prehistory.

If the who and why questions suggest that these islands mirror central sites on the mainland, the when question shows that this is not the case by identifying complex contradictions both within and between history, earth sciences and archaeology about the timing and nature of settlement. Firstly, the history notes that the islands were named after islands back in the Pacific by a directly connected Ngati Manaia ancestor. This implies an early naming process when memories of the Polynesian homeland were still current. However Chief Te Tatua is identified as the first and only chief to occupy and live on Tawhiti Rahi, in the period ending in 1823. Secondly, the history also states that islanders made use of food storage sites at Whananaki on the mainland coast which implies strong kinship connections. However there was also conflict between Poor Knights based islanders and mainland based people that led to an attack on Whakaturia Pa in Whangaruru Harbour. Third, carbon and independent tephra dates taken from the pollen record indicate that anthropogenic burning started very early in prehistory, that burning reoccurred within such a short time frame that only first succession plant pollen appear, and that such burning continued for 500 years until the island was abandoned in 1823. However this suggestion of long term and continuous use of the island appears to be in conflict with the absence of kiore (Polynesian rat) whose presence is found nearly everywhere else in island New Zealand. Whether or not rats were deliberately excluded or just did not accidentally arrive, their non-presence on the Poor Knights (and a few other) islands is not consistent with long term intensive settlement. The pollen record of ongoing and continuous use also appears to be in conflict with the archaeological evidence, where excavations in the built landscape and analysis of the portable material culture imply island use was not early, that it appears in the second half of the prehistoric sequence, that it became significantly more intensive late in prehistory and stopped only early in the historic period.

How then can these apparently incompatible data sets be reconciled?

6.1.1 Summary of Agreements and Contradictions Between Disciplines

The data collected using these three disciplines is robust and reliable but the interpretations are open to question. This is because all the data sets contain differing strengths and weaknesses which, if not fully understood can lead to interpretations in one discipline that can appear contradictory both within and across other disciplines.

For the history section the facts identified from the oral and written record can appear in conflict if they are assumed to happen at the same time. On this basis accounts of battles by Poor Knights

Islanders against mainland communities appears incompatible with the same islanders owning food storage areas on the mainland. However putting these events in a sequential time line, they can be coherently interpreted as being part of Ngatiwai territory, but that initial use was by a non-resident mainland population. It is only at a later date that there is a record of disputes and conflict between the islands and the mainland. This follows a mainland chief setting up a resident population on the islands

For the environmental science section the pollen and charcoal studies present a picture of dramatic change from a pre-human natural environment to an anthropogenic fire-modified environment, followed by ongoing use for 500 years before abandonment and native vegetation recovery. This interpretation is, however, based on large scale 'broad brush' data base that clearly shows the start and end of events through presence and absence scenarios, but it lacks fine detail needed to identify change in settlement intensity over time. Large events like a break in human occupation of greater than 20-40 or more years would be reflected as an observable absence of charcoal and presence of pohutukawa pollen in the core (as occurred post-1823). Increases or decreases in intensity of gardening may not be so visible. For example as long as people are burning the ground as the initial stage of gardening then pollen studies cannot tell us how often burning occurred in blocks of time less than 10-20 years long, since this is too short a timeframe for longer-lived tree species to appear and produce recognizable pollen. Similarly an increase or decrease in the intensity of gardening may not be visible in the charcoal record since burning every year for ten years or burning once every ten years removes roughly the same amount of vegetation fuel and produces the same amount of charcoal in the pollen core. Seasonal gardening by an initial non-resident population and later more intense gardening by a resident population is a possible scenario within the reconstructed vegetation history.

Archaeology is on the other hand a fine-detail data base. The detailed mapping in the survey tells us a great deal about the last period of occupation defined by the distribution of surface structures and portable material culture visible on the ground today. However this is palimpsest landscape and we remain unclear about when component parts were built and what if any earlier structures still exist. The timing of settlement must be taken from limited excavations where carbon dates could be found and this is always site specific. For example in the absence of other comparable dated sites the cave excavation can only tell us that people were on the island by 320-480 BP and were also here in proto-historic times. It is probable that this represents limited early use, a break in settlement and then late period use. However the sterile material between these two dates may occur only in this one site and not reflect an island wide break in settlement. In a similar vein, settlement elsewhere on the island earlier than 480 BP,cannot be ruled out.

Some portable material culture appears to support a short and late settlement hypothesis. This is consistent with the lithic analysis but contradicts the long history of settlement posited by the pollen and charcoal record. At first glance the presence of extensive obsidian artefacts from a late developing regional obsidian source and the near total lack of Mayor Island material that dominated lithic assemblages in early New Zealand sites, suggests occupation was late. However, this interpretation is based on the assumption that every occupation or visit will leave lithic artefacts behind. On this circumscribed island, access difficulties and limited water supply may have meant that for much of its history the island was not permanently inhabited. In this scenario the non-resident population that was gardening the island did not need to use stone tools so did not bring them. It is only later when a resident population gets established late in prehistory that such tools are needed, obtained, and subsequently left behind in the archaeological landscape.

The following sets out a synthesis interpretation that uses the complementary strengths of these three very different disciplines to offset their weaknesses. It incorporates all of their key data points identified but interprets them only in ways that are compatible with the history, palynology and archaeology so as to create a coherent story.

The three disciplines studied in this thesis suggest that Tawhiti Rahi was part of a recognised iwi (tribal) territory from early in prehistory but that the nature, intensity and timing of settlement on this island changed over time.

6.2 The story of Tawhiti Rahi Island

6.2.1 Early Days

The initial burning and gardening of Tawhiti Rahi Island occurred at around the same time as the arrival of the first generation of Polynesian explorers and settlers to Northland. These people were modifying the island prior to the Kaharoa eruption of 1314 AD. The difficulties of access along with a lack of any early tool types, or of Mayor Island obsidian, suggests that this initial cultivation was by a highly mobile non-resident population. Known traditionally as Ngati Manaia these people were predominantly located on sheltered, easily accessible and resource rich estuaries along the east coast of Northland.

Within such a large territory, the small founder population would have had access to a number of places on islands and the mainland with rich gardening potential that they used as garden outliers. Having access to more places than they could easily use, they are likely to have optimized their gardening strategy on places like Tawhiti Rahi Island by investing minimal effort beyond burning, planting crops in the ash and then harvesting. This low intensity gardening approach would have provided low to medium productivity although the produce from a number of such sites would provide a significant harvest. This is also a risk avoidance management strategy whereby multiple dispersed gardens would minimise the impact of losses at any one site caused by accident, weather or disease.

The lack of kiore on the island is probably explained by the minimal human presence and lack of permanent settlement where kiore as a food delicacy might have been imported. It is possible the food grown on Tawhiti Rahi and other garden outliers was being stored at this time on the mainland. In these early days it is unclear how much of the fisheries around this island and the mutton-bird resources on this island were utilised, while the more easily accessible mainland coastal fisheries and seabird colonies remained viable.

6.2.2 Later Days

For at least 400 years from about 1300 AD mainland-based communities of people had territories within which a range of resources were seasonally accessed and within which seasonal or longer term settlements came and went. Within this scenario it is suggested that Tawhiti Rahi remained an important garden outlier for a non-resident population but, due to the constraints of difficult access and limited fresh water, was not chosen for permanent resident settlement. As such anthropogenic burning remained the most significant evidence of human presence since built structures to live in and flake and ground stone tools for settlement activities were not required. It is likely that the mutton-bird resource became more important within the first 100 years as mainland colonies succumbed to multiple threats from indirect and direct predation. In general the east coast fisheries of Northland remained a viable resource throughout prehistory. By these later days however the high biomass of tropical and local fish around the Poor Knights and especially the large fat-rich Hapuka (groper) from the fishing grounds east of the islands would by now have been recognised as an important maritime resource. As such they would have been line-fished from canoes through this period.

With the increase in population, tribal territories were now smaller, with mostly internal mobility, and mostly bordering directly with neighboring groups. Competition over increasingly scarce resources, land and mana saw an increase in conflict between groups and the distinctive development of defensive sites known as pa after 1500 AD. Sometime in the late 18thcentury after European explorers had arrived, these pressures in Māori society were instrumental in a fundamental change whereby Ngati Manaia became known as Ngatiwai. For the first time Tawhiti Rahi was deliberately and permanently settled by chief Te Tatua, his wife Te Oneho and their people. Such refuge or migratory settlement required a number of secondary changes. The island topography provided a strong natural defense and was probably a major factor in the decision to relocate. Since built defenses were not needed no pa were built. Horticulture became more productive as increased labour inputs became available for the construction and maintenance of integrated garden designs, clearing of loose rock from garden areas and construction of walls, terraces, mounds and rows. This activity was intended partly to maximize growing potential but probably also to define whanau (family) boundaries. New areas are likely to have been opened up for kumara cultivation on the northern plateau while wetland taro gardens appear for the first time in the southern Charles Stream. Habitation sites appear in both dispersed and hamlet form while portable material culture now includes a full kit of regionally-located ground and flaked stone tools. Specialist sites to support this settlement now appear, including landings, waka (canoe) storage, lithic work floors and food storage. Most importantly ceremonial places associated with burials in various forms now appear and show an intention to stay. At this time mutton-birding to produce a high status food item was underway and this now rare item on the mainland would have been used for exchange, gifting and trade to offset the islands' lack of totara wood for structures, various lithic materials and sandy shore shellfish resources. It is likely that the islanders retained strong links to their previous home on the mainland, where the distinctive water-rolled boulders probably came from, but interestingly they also had links through local obsidian to related kin groups on Aotea (Great Barrier) (Figure 6.1).

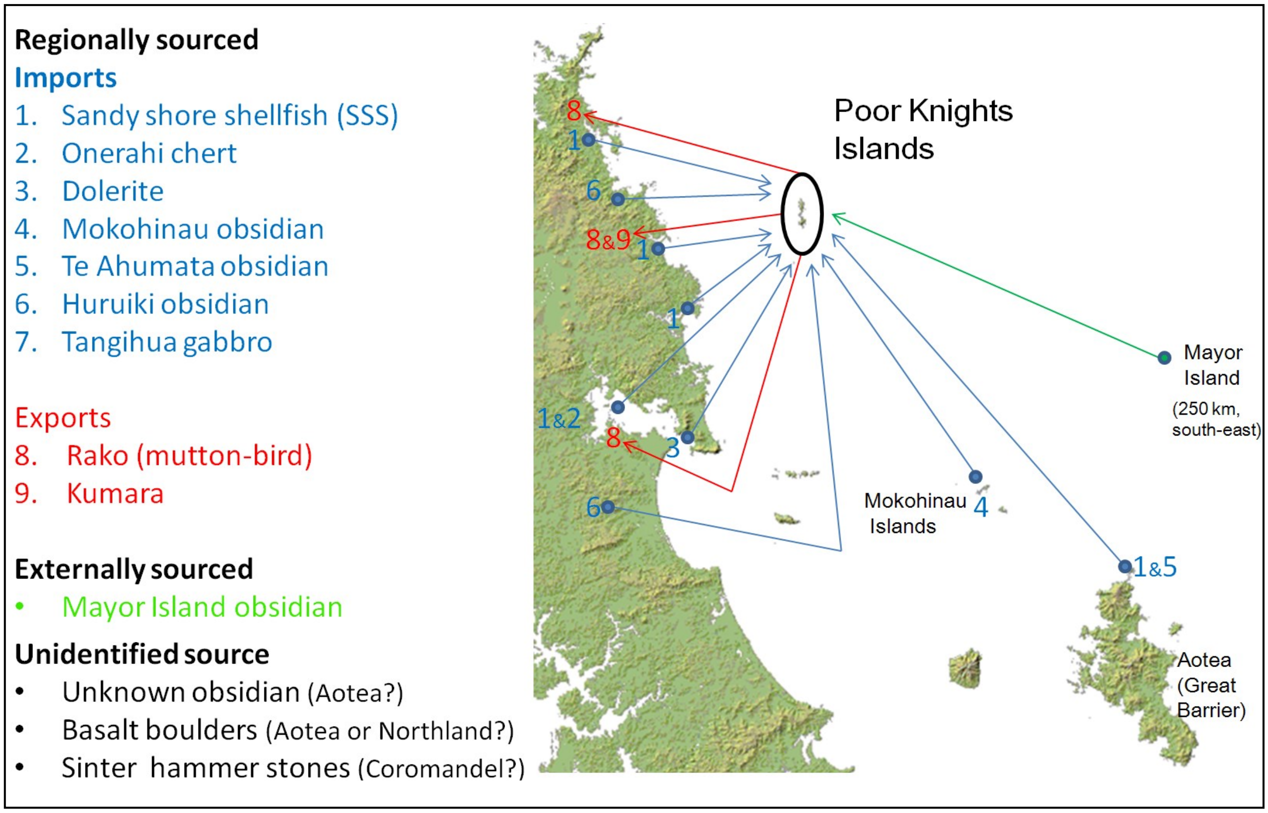


Figure 6.1 Poor Knights Islands, exports and imports.

By 1823 a resident rather than transitory settlement was likely to have been established for 20-40 years. Extensive gardens were all being used and expanded and little unmodified surface ground remained. Formal structures including a carved meeting house are implied by the cached building panel. Te Tatua is now taking part in Ngapuhi war parties heading south. A small number of recognisable European influences can be identified. These include the establishment of a breeding population of pigs on the adjacent Aorangi Island that may have been part of the whaling fleet provisioning trade, the cooked pig bone found in the cave site on Tawhiti Rahi and the presence of the carved panel whose construction involved both stone and metal tools. It is unclear what, if any, role the white potato had on the Poor Knights Islands. Inter-hapu conflict occurred with a well-documented attack on both Tawhiti Rahi and Aorangi Islands in December 1823 which led to the islands being abandoned. The subsequent transportation of the dead back to mulptiple places along Northlands east coast from Rawhiti south nearly to Whangarei for burial reaffirming hapu connections including that of Ngatitoki between Aorangi Island and Matapouri Bay, and of the Whananaki people to Tawhiti Rahi and the area between Mimiwhangata and Whananaki Harbour.

The following sets out an interpretation of part of the Ngatiwai coastal region. Using various presence and absence scenarios identified on the Poor Knights Islands, a maritime-influenced model of changing use and settlement is set out.

6.3 Regional Synthesis from the multidisciplinary study

6.3.1 Regional Model.

When the first Polynesian colonists arrived in New Zealand they were highly mobile in their sea going waka (canoes). Small populations rapidly explored the coastal areas of the country and identified the spectrum of resources they could make use of. Like most people's moving into uninhabited areas they initially focused on the richest and easiest resources available. In terms of food resources the flightless moa became the focus of attention in the South Island (Davidson, 1981) and parts of the North Island, but in warm temperate Northland it became focused on a variety of smaller resources. One of the most important of these was any area suitable for growing kumara and other crops. Within this frame of reference Tawhiti Rahi Island was a near perfect locality for kumara cultivation. It had silty volcanic soils with bird-induced fertility, was located in an island environment where frosts do not occur due to the marine effect, contained large areas sheltered from the storms and salt spray and had orthographic rain and fogs to offset seasonal rain shortfalls.

The first generation(s) ofPolynesians who settled in Northland did not, however, live on Tawhiti Rahi Island. Instead they settled mainly around the more benign and resource rich harbours along the eastern seaboard of Northland. They utilised the Poor Knights and probably other peripheral islands such as Taranga and Marotiri (Hen and Chicken Islands) as garden outliers. It is likely that in these early days a minimal amount of effort was necessary to produce crops from multiple localities. Using a slash and burn approach brought from the Pacific the islands would have been regularly burnt, planted and harvested with no other input required. Even at low intensity levels, such gardening would have resulted in the forest vegetation on islands like Tawhiti Rahi being burned off within the first 20 years with grass and fern succession species remaining dominant in the vegetation record even if subsequent burning occurred only in five to ten year cycles.

Over time the small mainland populations would increase in size and secondary settlements would spread along the coast. At the same time wild resources such as seal colonies, terrestrial moa and mutton-birds would decline due to indirect and direct predation by humans and their commensal dog and rat. Peripheral islands however remained as garden outliers but the mutton-birds that breed on them became progressively more important as their mainland cousins disappeared. It is probable that this focus on seasonal resource gardens and mutton-birds made it easy to identify the threat that rats posed and to develop cultural practices to stop their deliberate or accidental introduction onto all of the Poor Knights and some of the Marotiri islands. Over time all the easily accessible environments on the mainland came into use and the territories of individual hapu started to intersect regularly with adjacent groups, eventually culminating in conflict.

Sometime in the second half of the18th century a long process of resource and mana competition led to escalating conflict both within and between tribal groups. On the mainland, Ngapuhi expanded into the Bay of Islands (Sissons et al, 1987; Lee, 1996). Although Ngatiwai developed kin ties to both the neighboring southern branch of Ngapuhi and with Ngati Whatua to the south they remained at risk from their larger neighbours. In response, existing kin ties across the seascape became strengthened between the mainland and Great Barrier Island. First a major kin movement out to Aotea occurred that saw the establishment of the closely affiliated Ngati Rehua group as a major force on Great Barrier Island. At a later date small populations on the Mokohinau and Hauturu Islands become component parts of this seascape. Late in the 18th century a subsequent battle was fought at Mimiwhangata and local Ngatiwai were defeated by northern hapu of Ngapuhi. As a direct result some of these Ngatiwai people who had interests on adjacent offshore islands migrated there, to permanently settle the peripheral islands of the Poor Knights, Marotiri and Taranga. At least partly as a refuge this deliberate settlement of permanent habitation on peripheral islands was driven by social and political imperatives on Northland and Great Barrier 'mainands'. Major attempts were made to increase productivity of garden and wild resources, including the establishment of a European-sourced pig colony on Aorangi. However these peripheral islands remained too small and lacked too many key resources to become truly self-sufficient. Sustaining and maintaining the settlements required complex social and resource connections across the wider Ngatiwai seascape – as is reflected in the presence of lithics and shellfish from many mainland and Great Barrier localities.

The attack in 1823 on the Poor Knights only 20-40 years after permanent settlement was established was only one of a series of such events on islands and small mainland settlements up and down the Northland coast and out to Great Barrier. While Ngati Rehua on Aotea could call on Coromandel based Ngati Maru for help (Murdoch, 1993), the smaller islands had fewer options. The subsequent abandonment of the Marotiri, Taranga, and Poor Knights Islands, the setting of a tapu and the return to the mainland was probably considered to be a temporary break in occupation. However the significant changes in mainland Māori life that occurred in the 19th century drove the subsequent non-use of the island. It is probable that Māori horticultural efforts shifted more towards European crops that did not suit the island environment and so the island did not return to its earlier garden outlier status. Similarly, the overriding need for defense that drove permanent settlement in the contact period was removed as inter-tribal conflict declined after the 1830s. With its advantages of easy defense and good gardening soil no longer relevant the island did not return to its resident settlement status.

6.4 Conclusion

This multi-disciplinary research has shown that the trajectory of settlement on peripheral islands differs in some important respects from that found on mainland places in this coastal region.

The range of natural circumscriptions present on Tawhiti Rahi caused people to use it in ways that are observably different from mainland sites. These differences appear as presence and absence scenarios or as differences in the timing and nature of events. While such variation in central locales can have multiple explanations, in circumscribed environments there are fewer viable explanations available. When such variations are looked at in a cross-disciplinary perspective, for example on a peripheral island, there may be only a small number of explanations that satisfy the archaeological, palynological and historic records.

In this thesis environmental change is a primary theme. It is identifiable by all three disciplines but is expressed differently in each. When the individual strengths of the three are compared and contrasted a testable interpretation can be made. For example, the palynology shows the timing and extent of burning assumed to be anthropogenic. The history identifies that gardening did occur and what was grown, who grew it and where the harvest went. The archaeology identifies extensive constructed gardens, food stores and the presence of at least hue (bottle gourd) as a crop. It also identifies increasing intensity of use and substantiates the idea that the island changed from a low intensity garden outlier to a resident settlement with high intensity horticultural production.

Degrees of connectedness are how this research defines insularity. Places that are central, that have few barriers to their use are automatically well-connected culturally. Those locales with a high degree of circumscription are automatically less culturally connected. Tawhiti Rahi has significant circumscriptions that have strongly influenced how it was used. The decision to work within these circumscriptions or to override them was culturally determined and was ultimately contingent on what was happening in the wider community. Early on, its initial garden outlier status began because the non-resident population saw advantages in low level horticultural use and this continued for as long as it provided added value. For a long time access and fresh water constraints were types of circumscriptions significant enough to limit connectivity and prevent these islands from being permanently occupied. It was late in the prehistoric period, when culturally defined issues of defense became paramount, that mainland people decided to permanently settle on Tawhiti Rahi and make the effort to mitigate these very real limitations by increasing horticulture production and the seasonal harvesting of the now rare mutton-birds. The presence of pigs on the adjacent island of Aorangi reflects a similar mitigation technique.

The final abandonment of the island followed an inter-tribal attack in 1823 that was set up and perpetuated by social and political issues on the mainland between hapu of Ngapuhi and Ngatiwai. The subsequent tapu placed on Tawhiti Rahi restricted the use of these islands to a fishing locale. Although this tapu was probably considered to be of a temporary nature the radical changes in mainland Māori society in the 19th century brought about by European contact and the end of endemic tribal conflict removed any incentive to again permanently settle these peripheral islands.

6.5 Future work

Tawhiti Rahi is an archaeological landscape that presents a remarkably well preserved and contemporary picture of late prehistoric Māori society. Because of the unique nature of the islands physical circumscriptions, its intense but short term use and then abrupt and permanent abandonment, this island provides a relatively undisturbed and controlled resource for further archaeological, earth science and historic research.

Apart from the obsidian studies, this large and detailed GIS database created for my doctoral research has to date been primarily used as a qualitative research tool in this thesis. The opportunity is here to carry out a range of quantitave studies on the structural features that should includes, but not be limited to, the following suggestions.

<u>Archaeology</u>

- Future research should remain multi-disciplinary and have an initial focus on food resources. In terms of field archaeology, further survey and excavation would aid in understanding the structure and chronology of gardens on this island, and then comparing them to similar sites on other islands and the mainland.
- The comprehensive GIS data base for Tawhiti Rahi should be tested against an aerial 'Light Detection and Ranging' (LIDAR) survey of the island. LIDAR should work well here as there is only a single canopy of forest so problems of 'signal bounce' between multiple canopies are not an issue. If the different categories of features identified by the thesis field work can be differentiated in the LIDAR results, this will allow (i) areas of the island that are currently 'out of bounds' due to being Buller shearwater colonies to be assessed, and then the results can be added to the GIS as an additional indirect layer, and (ii) aerial LIDAR on Aorangi to create an indirect feature layer that could be compared to Tawhiti Rahi. Any significant differences could then be tested on the ground to determine if these were associated with pig farming, and (iii) other aerial LIDAR on other island groups such as Taranga (Hen) and Marotiri (Chickens), that are thought to have a similar type of Māori occupation. Specifically the LIDAR results would be analysed to recognise 'presence' and 'absence' scenarios of features and ask whether there is any fundamental difference in feature types or feature concentrations between island groups.
- Quantitative obsidian research should include (i) laboratory based pXRF analysis on the Tawhiti Rahi obsidian collection to confirm ppm results from Auckland University, and the results should then be published. (ii) This should be followed by a field based pXRF sourcing study that examines surface obsidian on coastal and estuary sites along the western coast of Aotea (Great Barrier Island), to try and find obsidian with the same geochemical signature as that which dominates the Tawhiti Rahi assemblage. (iii) A field based pXRF sourcing study that broadly analyses obsidian along coastal middens along the Northland coast and coastal islands, up as far north as Te Paki and south as Auckland. It is anticipated that this 'presence' and 'absence' approach should identify the distribution of the Tawhiti Rahi type obsidian.
- Quantative basalt research is needed to source the water rolled boulders identified on the on Tawhiti Rahi that must have been imported from some high energy water environment. Using pXRF, a primary analysis of naturally occurring water rolled boulders should be made from coastal river mouths on the Northland mainland and on Aotea. This will provide a

geochemical 'finger print' of central Northland water rolled basalt that the Tawhiti Rahi boulders can be compared too.

Earth sciences

Three approachesare proposed to explicitly identify cultigens grown, and their distribution and association with mapped structural features.

- First, if soil DNA studies currently underway at Landcare Research are successful, then soil samples already collected from a range of cultural and non-cultural locations on Tawhiti Rahi, should be tested to identify whether introduced cultigenswere being grown, and if so, what species were present. This will address questions raised in this thesis about Māori use or non-use of land with no obvious structural modifications, whether terraces were used for gardens and/or habitation, and determine specific crops being cultivated on this island in the historic and prehistoric periods.
- Second, in a parallel and independent approach, existing phosphate analysis techniques should be applied on Tawhiti Rahi to test (i) the garden/habitation model for constructed terraces and (ii) whether areas that lack earth or stone structures were not used, gardened or had some other purpose.
- Third, in a parallel and independent approach, if current research underway in starch grain analysis (J.Maxwell pers. comm 2015) is successful, then this analytical technique should be applied to test (i) the garden/habitation model for constructed terraces and (ii) whether areas that lack earth or stone structures were not used, gardened or had some other purpose.

Further pollen coring should be attempted in two areas.

- First, adjacent to the Flax Stream site a larger volume core should be taken. This should (i) recreate the 1900 year sequence identified by Wilmshurst and (ii) provide a quantity of pollen large enough for AMS radiocarbon dating. If successful this will test the modelled dates currently provided by bulk sediments, with dates from material with known and limited in-built age issues.
- Second, a larger volume core should be taken on the northern plateau in stream areas adjacent to the North-East garden (R06-90) where sediment traps could have preserved a vegetation sequence. This should inform us as to whether forest clearance and garden activities have the same chronology as was found in the southern lowlands. .

History

In partnership with the Ngatiwai Trust Board, traditional research in the Whananaki, Whangaruru and Takahiwai areas should be undertaken to (i) identify the back story to the settlement of Tawhiti Rahi, and (ii) determine the role mutton-birds, pigs and European sourced cultigens might have played in the island economy.

APPENDICIES

Appendix 1

Transcription of this Court document was made by James Robinson on 19th May 2012.

Note: The spelling of Tawhiti Rahi has been changed slightly to conform to that used elsewhere in this thesis.

Native Land court sitting at Whangārei on Sunday, 28 September 1928

About: Tawhiti Rahi, or Poor Knights Islands.

Application by Chief Judge over sec of 1928 act for inquiry and response. Paris petition one 670-1925 of Maki Pirihi

Mr. Parore appears for petitioners
Mr. Meredith (Crown solicitor) appears for the Crown

Court petition read out to assemble natives. Among those present are:
Hana Paengatai
Mita Nepiha
Maki Pirihi
Pouaka Wehiwehi
............Pirihi
............Retimana
Ngahina Nepiha + others

Page Mr Parore: [Complaint about access to files being denied]

244 The original documents re: Polachs claim has never been produced to the courts.This is a myth as far as the natives are concerned.

245 Hana Paengatai:

I am related to the first Te Tatua, a distant uncle of mine. His son was Hōri Wehiwehi, a cousin of mine. Hōri 's son is Pouaka Wehiwehi. I am related to Pouaka's mother.

246 Pouaka Wehiwehi was born at Whangaruru -- aged nearly 40. His father Hōri Wehiwehi was born at Tawhiti Rahi (Poor Knights).

I know Hōri Wehiwehi very well indeed, we were always opposed to each other.

Hōri Wehiwehi was an old man, older than Mita Nepiha when he married a young girl and had a son Pouaka Wehiwehi.

I know the tribal traditions about the massacre on the poor Knights. I am 97 years old. I must have been very young at the time of the massacre.(Court; native could hardly have been alive at time of the massacre).

According to traditions Hōri Wehiwehi was on Tawhiti Rahi when the massacre took place. When the attack took place the slave took hold all of Hōri Wehiwehi's hand and rushed with him to the edge over the cliff and climbed down a Pohutukawa vine...

247 ….to a cave in the face of the cliffs, and hid there. Te Tatua's wife was Te One Ho, the mother of Hōri Wehiwehi. She was captured and taken away by the attacking party, together with three other female relatives.

The other people on Tawhiti Rahi were massacred, either killed by the enemy, or killed by jumping over the cliffs. Hōri Wehiwehi and the slave (Omana) watched the massacre from the cave.

Hōri Wehiwehi's father was Te Tatua, who was the rangatira. He claimed the island as his. He was away leading a war party off his people, and it was in his absence that the attack place.

Te Hikutu tribe from Hokianga, under Te Whare Pouaka and Tura as leaders, were the attackers.

The trouble arose over a pig. A man named Paha who was on Tawhiti Rahi quarreled with someone else over a pig, and because of this quarrel he wanted revenge. He communicated with [Chief] Waikato on the Mainland and told them to attack the Island while it was undefended.

Waikato called the messenger to go elsewhere, as he was related to the people on the island.Waikato suggested that the messenger go to Te Whare Pouaka and Tuma at Hokianga, so he went.

After the massacre Te Tatua returned with his war party and found that the people had nearly all been killed or taken away as prisoners. He found 20 survivors, principally woman who had hidden themselves among boulders and shrubs. He also found his son and the slave.

Te Tatua stayed there for a while gathering the remnants, and brought them to the mainland to Rawhiti (Block I) and other places along the coast.

I never heard off Te Tatua returning to the islands and that he was the last man occupy the islands.It is against Māori custom....

249 ....for survivors to return and live again on the scene off a massacre. The island became Tapu with the blood of the dead. The descendents of the survivors would not go back live that either, they would be afraid on account of the Tapu.

Once a place became Tapu it was made into a reserve, a 'rahui' . It was not sold or given away to strangers. That was the old custom. Modern custom seems to be different.

There were no inhabitants of the island before Te Tatua's time so he went there and occupied it. His tupuna Panoa went there first. This was before the coming off the white man.

The people on the mainland admitted to Te Tatua's right to the island. No one ever went then to interfere with him or dispute his occupation.

The other people who lived on the islands......

250 ......were the Ngatitoki hapu on Aorangi Island.Tuaho was their chief. They are in the the small island Aorangi. Te Tatua did not exercise rights over Aorangi, but he did over the largest island Tawhiti Rahi. But at times Te Tatua and his people went and lived on Aorangi, through the mana of Tuaho. Tuaho had no mana over Tawhiti Rahi.

Both islands were attacked at the same time.

I know the people entitled to Tawhiti Rahi, but as many of them are lazy and have not taken any active part in this matter I will not recognize them.

On one occasion smoke was seen on Tawhiti Rahi from the mainland, and Hōri Wehiwehi instructed Wiki Pirihi to go......

251 ..... and investigate and to warn off the island anyone found there. It was a 'Pakeha' . He was ordered off, and went. I don't know his name.

Repeatedly the natives have gone to Tawhiti Rahi on fishing excursions, but the islands being Tapu the natives kept to the beaches and did not venture inland.

The hapu of Te Tatua was 'NgatiManaia', but he was also a member of 'Ngatiwai' and 'Patutahi' hapu's.

I claimed that both islands and Aorangi and Tawhiti Rahi are still native land.

[Cross examined by Mr. Meredith] Han Paengatai;

I saw Te Tatua, he was well tattooed. I was told that both Tawhiti Rahi and Aorangi were full of people before the massacre took place. After the attack the whole place smelt of the dead. I heard that 40 man went south with Te Tatua. There must......

252 ..... have been 50 or more left on the island, because the dead lay all over the place. Two canoe loads of dead were taken and buried at Roimata.

One big canoe took the war party to the south [prior to attack on island]

Te Tatua and Tuaho were the two principal men on the islands. Tuaho was the rangatira on Aorangi Island. My elders went with Te Tatua on his expedition.

Appendix 2

A.H. 'Pick' Pickmere's archival documents are held by the Pickmere family and curated by his daughter Janet M. Watkins. Access was kindly given by Ms Watkins for extensive material related to the Poor Knights to be examined and copied by the author. Key documents are included here.

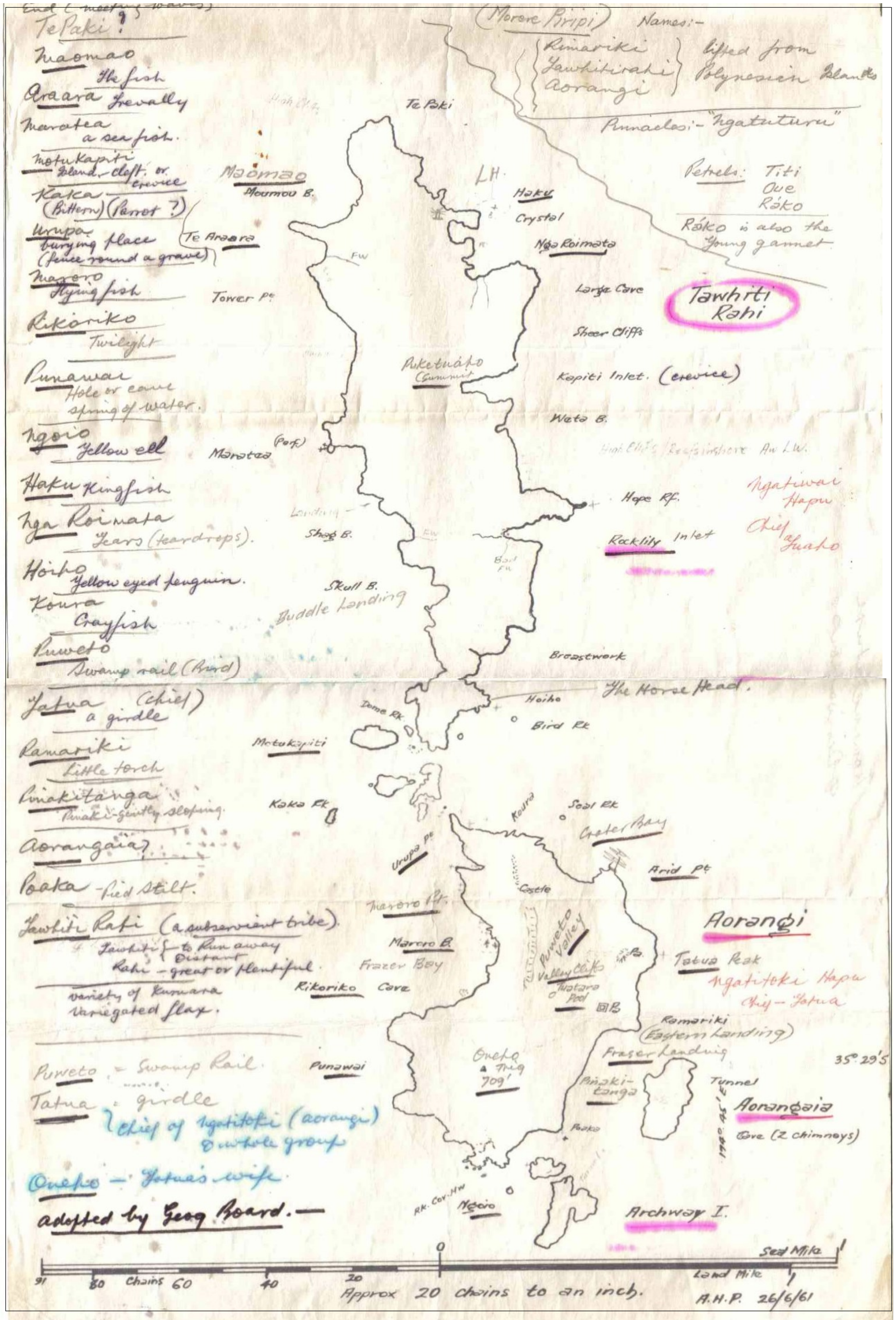
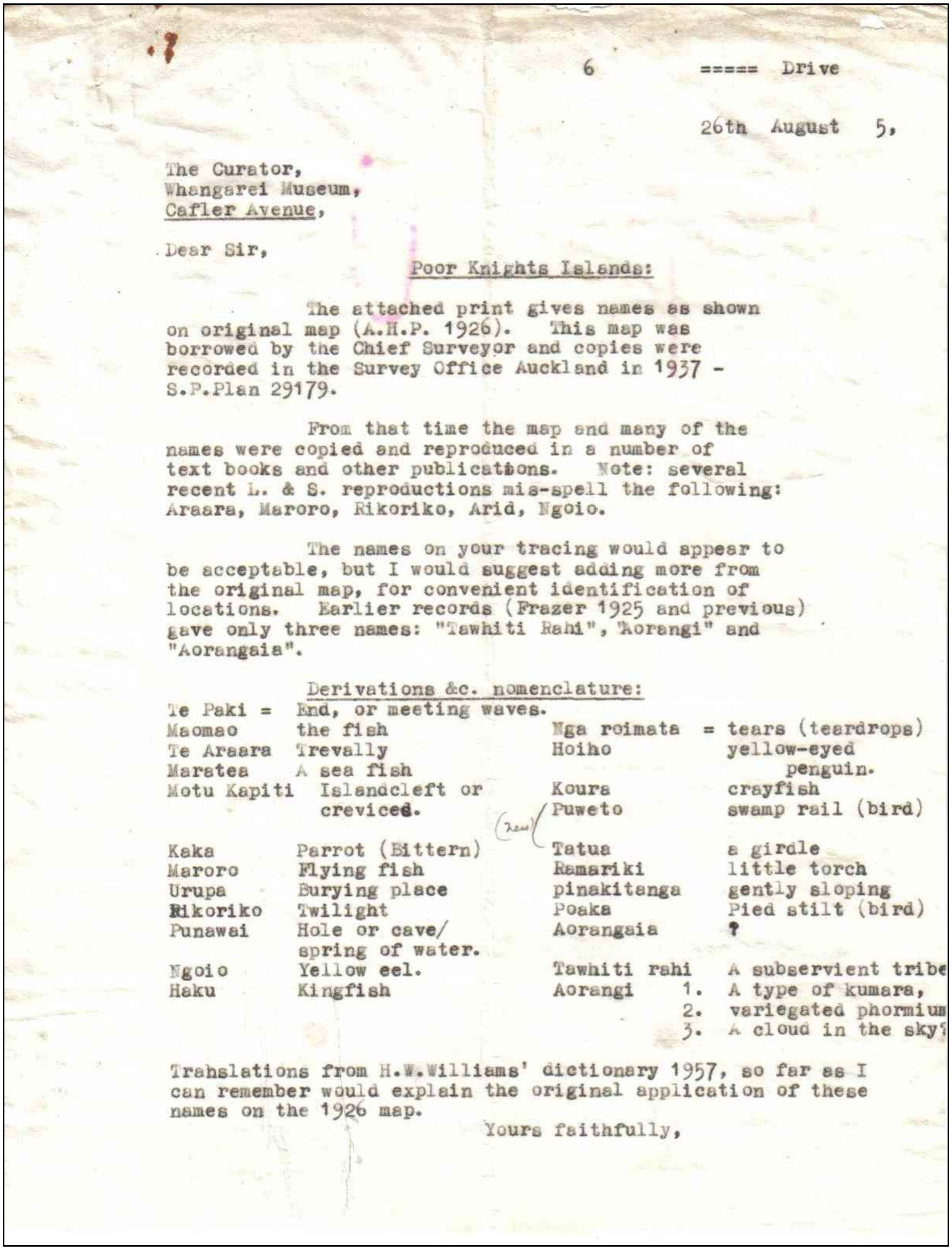


Figure 1 Shows the whole map partially reproduced as Figure 3.09 in chapter 3. Dated 1961 it till refers to Chief Te Tatua being Ngati Toki and living on Aorangi Island



6 ===== Drive

26th August 5,

The Curator,
Whangarei Museum,
Cafler Avenue,

Dear Sir,

Poor Knights Islands:

The attached print gives names as shown on original map (A.H.P. 1926). This map was borrowed by the Chief Surveyor and copies were recorded in the Survey Office Auckland in 1937 - S.P.Plan 29179.

From that time the map and many of the names were copied and reproduced in a number of text books and other publications. Note: several recent L. & S. reproductions mis-spell the following: Araara, Maroro, Rikoriko, Arid, Ngoio.

The names on your tracing would appear to be acceptable, but I would suggest adding more from the original map, for convenient identification of locations. Earlier records (Frazer 1925 and previous) gave only three names: "Tawhiti Rahi", "Aorangi" and "Aorangaia".

Derivations &c. nomenclature:

Te Paki =	End, or meeting waves.		
Maomao	the fish	Nga roimata	= tears (teardrops)
Te Araara	Trevally	Hoiho	yellow-eyed penguin.
Maratea	A sea fish		
Motu Kapiti	Islandcleft or creviced.	Koura	crayfish
		(new) Puweto	swamp rail (bird)
Kaka	Parrot (Bittern)	Tatua	a girdle
Maroro	Flying fish	Ramariki	little torch
Urupa	Burying place	pinakitanga	gently sloping
Rikoriko	Twilight	Poaka	Pied stilt (bird)
Punawai	Hole or cave/ spring of water.	Aorangaia	?
Ngoio	Yellow eel.	Tawhiti rahi	A subservient tribe
Haku	Kingfish	Aorangi	1. A type of kumara, 2. variegated phormium 3. A cloud in the sky?

Translations from H.W.Williams' dictionary 1957, so far as I can remember would explain the original application of these names on the 1926 map.

Yours faithfully,

Figure 2 Dated from 1965 this draft letter from Pickmere to the Whangārei Museum shows that the island names' Tawhiti Rahi', 'Aorangi', and 'Aorangaia' come from Rangatira Morere Piripi and are transplanted from Polynesia.

64 Hatea Drive,
Whangarei,
26/2/1966.

Dear Mr. Bartle,

re <u>Poor Knights:</u>

Replying to your letter of 19/2/66, additional notes and references:-

Journal of Science and Technology, Vol.VIII No.1 1925
pp. 8 - 14 : W.M.Fraser.

Tuaho was the chief of Ngatiwai hapu on Tawhiti Rahi.

Tatua was the chief of Ngatitoke hapu on Aorangi and ruled over the whole Group.

Oneho was Tatua's wife.

The late Morere Piripi of Whangaruru informed me that the names "Rimariki" (Wide Berth Islands), "Tawhiti Rahi", "Aorangi", and "Maro Tiri" (Chickens Is.) were transplanted from Polynesia, and as proper names it might be inferred that there is no literal maori translation.

O.L.C. plans 205 (Tawhiti Rahi) and 206 (Aorangi) were made for one J.S.Polack in the 1860's but, so far as I know, show only the principal names.

Comments:-

3. Tuaho Hill = Puketuaho (omit "Summit" ?).

4. Rocklily (I think should be one word).

11. W.M.Fra~~z~~ser.

18. Puweto. Stet. I agree with this name and its origin.

19. Error. "Tatua" is preferred, see note above. Described by Frazer as Large Pa, was probably Tatua's main fortress. Also, the name "Tatua" means a Girdle and is a good description of the physical appearance of this peak, from seaward.

20. Oneho is correct, but "Puweto" should be changed to "Tatua". And the authority in this case should be quoted as Fra~~z~~ser, not A.H.P.

You might have to re-type page 5, amending as noted, but I have signed p. 6 as requested, so that the submission may proceed without delay.

Yours faithfully,
A.H. Pickmere

Figure 3 Shows that all other locality names on the Poor knights islands are recent constructs made by either Pickmere or William Fraser. By this point Pickmere has acknowledged that Te Tatua was Chief on Tawhiti Rahi.

Appendix 3

The following unpublished document was provided by Lynda Walter who spent a number of years on these Mokohinau Islands where her father Ray Walter was light house keeper. This is one of a series of research essays Walter wrote in the late 1980s about the history, archaeology and environment of the Moko Hinau islands while completing her Masters degree at the University of Auckland Department of Anthropology (L.Walter, 1987). The section relevant to the Poor Knights is included here.

THE LAND OWNERSHIP HISTORY OF THE MOKO HINAU ISLANDS A CASE STUDY 1844 - 1986.

NOT FOR COURSEWORK CREDIT TO 03 418

Lynda Walter 1987 University of Auckland research paper (copy held by Robinson)

On 15 July and 1 August 1844 the following advertisement appeared in the "Māori Messenger":

"Kia rongo nga tangata kotoa ki tenei pukapuka - kua hokona enei motu a Tawitirahi, a Marotiri, a Pokohinu e poreka i a Ngatiwai: ko Maini ratou ko Pokai ma nga kai tuku na, kaua te tahi tangata e poka noa Id te tuku; enei motu kua hokona ketia e Poraki."

"Harken all men to this notice. The Islands of Tawitirahi, Marotiri and Pokohinu have been bought by Polack from the Ngatiwai; Maihi (Marsh Brown Kawiti) Pokai and others are the sellers. Let no one interfere by attempting to sell these islands which have been bought by Polack." (Māori Gazette. 1844: No.7 vol.4).

This is first of J S Polacks illegal moves in relation to the Poor knights (Tawhiti Rahi) , Hen and Chickens (Marutiri) and Moko Hinau (Pokohinu). At this stage no legally binding sales had taken place, and it was not until 14 January 1845 that Polack applied to Governor Fitzroy for a waiver of pre-emption. This would enable Polack, under Fitzroys proclamations, to buy the islands directly from their Māori owners. (Pre-emption Certificates 137, 152 & 173. Old Land Claims file 1210).

Polack obtained, on 16 January 1845, the signatures of eight "chiefs" – Maihi, Pokai, Rerihou, Aupeki, Keke, Tini, Ihu and one other (whose signature is unreadable on the Deed of Sale), who agreed to sell the islands.

However, this action of Polacks *was* also illegal as the Pre-emption Certificate was not granted until 17 January 1845 - that is one day after the Deed of Sale was signed and one hundred and twenty-two pound, -fourteen shillings in goods (including firearms) were given by Polack in return for the islands. (Memo 45/1267. 1345: Old Land Claims file 1210).

Polack enquired to the Governor, on 4 November 1845, as to when Crown Titles would be issued for his purchases. On 1 May 1846, he applied to Governor Grey for Crown Grants of all three groups (Poor Knights, Hen and Chickens and the Moko Hinaus). He also enclosed a survey of the islands done by Captain Duperry in 1827, claiming he himself had been unable to carry out a survey due to a lack of anchorage at the islands. Polack also stated on 7 August 1545, that the original Deed of Sale had been lost due to an explosion at his home in Kororareka in March 1S45; however, acopy had been made and attested to by the original witnesses of the sale. Sir George Grey referred the matter to the Members of the Executive council for a decision. The Council reported that Polack had not lodged certified copies of his Deeds of Purchase as was required under Clause 9 of Fitzroy's Proclamation, and under Clause 10 no Crown Grant could be issued until one year after the Deeds were lodged. (Correspondence to the Colonial Secretary from Polack: Old Land Claims file 1210).

In response to this Polack forwarded a copy of the Deed of Sale for all three groups of islands. Governor Grey then informed him that the matter had been referred to the Secretary of State. Two years later, 22 May 1848, Commissioner Matson reported to Governor Grey that Polack still had not sent in any survey of the islands. Gray then disallowed Polacks claim to all three groups of islands (Government Gazette: 12 June 1845). Polack protested this decision by letter. (Bell. 1864 report. Old Land Claims file 1210).

The reason for Polacks purchase of the Poor Knights, Hen and Chickens and Moko Hinau's and the Crowns eagerness to retain central of them became clear when on 27 November 1848 Frederick Whitaker and Theopiles Heale applied to the Governor to mine copper and other minerals on the Hen and Chickens, and they were willing to lease the land from the Crown and pay Royalties, if it was found to be a successful prospect, and if in fact, the islands were Crown land, The Surveyor-General replied that the islands were Crown land; however, Whitaker and Heals did not take out a lease and abandoned prospecting in February 1849. (Bell, 1864 report. Old Land Claims-file 1210).

Inthe same month Isaac Merrick - who had mined at Great Barrier Island, Kawau Island and Waiheke Island - applied for permission to occupy one island in the Han and Chickens group, now known as Coppermine Island. Permission was granted and on 17 November 1349 Merrick landed 20 tons of copper ore at Auckland (Moore, 1984:169). A lease had been formally granted to Merrick on 3 June 1849.

Polack, meanwhile, was upset by developments. He wrote to Governor Grey in April of 1949 from the California gold-fields, and requested confirmation of derricks right to occupy the island; he also requested to be sent a copy of the dispatch which had disallowed his own claims. The Governor replied on 13 May 1849 that Merrick had indeed been granted license. He also informed Polack that, although his claims had been disallowed, he would be repaid by the Land Fund any money he paid out in the original purchase from the Ngatiwai. (Bell, 1864 report. Old Land Claims file 1210).

Grey formally stated the reasons for disallowment of Polack's claim in a Minute dated 19 May 1849, The reasons for disallowment were:

1) The Deed of Sale was dated 16 January 1845 - before Pre-emption Certificates were granted.

2) A portion of the payment had been in firearms.

3) The islands were believed to contain valuable minerals.

4) The Supreme Court had declared Fitzroy's Proclamations illegal.

5) Due to the above, Polacks claim rested on a series of illegal proceedings. (Bell, 1364 report. Old Land Claims file 1210).

Polack notified Governor Grey on 28 May 1849 of his intention to go to England and lay his grievances before the Imperial Government. He then published an advertisement on the 6 and 7

July 1849, cautioning Merrick, and any one else, from interfering with his claim. (Southern Cross Newspaper. 6 July 1849 p.2, col 1,). Hs sent a copy of this notice to the Governor, requesting that it be placed in the Government. Gazette. The request was denied, (Bell, 1864 report. Old Land Claims file 1210).

In October of 1849 two Māoris lodged objections to Polacks claims. The first was Tawatawa, whose name appears on the original Deed of Purchase as one of four people who received additional payment; The reason for this additional payment being made is not known, nor is it known why one of the payees later lodged objection against a sale in which they themselves participated; Tawatawa stated that only one person named on the Deed had aright to the islands – Pihi.

One month later Crown Grant BIG 771 was issued in favour oft R S Thomson, However, in 1872 Thomson used the islands as security on a mortgage to W S Grahame, and later defaulted on payments, (Department of Lands and Survey file NP39/1 closed file vol 1).

On 6 September 1882, B Tanks & Co, an Auctioneers firm from Auckland, was instructed to sell all the islands, that is the Hen and Chickens, Poor Knights and the Moko Hinaus, following Thomson's default. (NZHerald, 4 September 1882). The Crown obtained all the islands for the sum of seventy six pounds. (Conveyance 77862(01/641)).

In September the Poor Knights group was Gazetted under the Public Reserves Act 1883, as reserved for Lighthouse purposes (NZGazette. 1883: 375 & 1325).

When Mita Wepiha and other member; of the Ngatiwai from Aotea, petitioned Parliament in 1924 for Fanal Island to be revested in them, their claim was based on the original land sale of all three island groups to Polack was invalid. An -inquiry was ordered under the Native Land Amendment and Native Land Adjustment Act of 1925 (A.J.H.R. 1929; G-6B). The Native Land Court met on 28 September 1928 in Whangārei under Judge Acheson. The main testimonies were given by Hone Paama - who was at that time 85 years old - and Mita Wepiha who had lead the 1924 petition.

Hone Paama testified that the "take" was through ancestry and occupation. Motukino had been a paa and place of cultivation for the Pokohinu variety of potato. One hapu had occupied Motukino and Aotea Ngatiwai had married into this hapu ever time. He claimed the original sellers did net have sufficient right to sell the islands. Paama also stated that the Chief Surveyor, Mr Heale, had offered him one hundred pounds, at the time of the erection of the Lighthouse on Pokohinu, for his interest in the islands, therefore, the Crown's representative recognised that Māori title had not been legally extinguished prior to 1878.

Mita Wepiha's testimony was concerned with Whakapapa of the Ngatiwai - whom he stated were a branch of Ngatimanawa, the children of Rangi Hokaia. (Native Land Court Minute Book 15, Whangārei).

The petitioners alleged, according to the A.J.H.R. 1929:

"That the Crown, having had knowledge of all the facts relating to the alleged sale to Polack, and having been aware of the reports of its own officers appearing on the Old Land Claims file, cannot claim now that at the auction at 1882, it was a bona fide purchaser for value without notice of the adverse claim of the Natives interested. Accordingly the Motukino Island should be restored to the Natives entitled".

The A.J.H.R. summary of the Court findings further states that;

"The Court is satisfied Motukino Island has for many generations past been used by the Māoris for fishing, and bird-nesting and bird-snaring, and cultivation purposes without hindrance. The Court is not satisfied that the signatories to the deed of sale in 1845 had any right to sell the land to Polack".

However, the findings also conclude that;

"The Court does not regard Motukino Island as being of arm great material or sentimental value to the Natives, and the Court considers that the Natives have more or less acquiesced in the loss of Motukino by not objecting to the Crown's admitted occupation of Pokohinu Island close by".

Hone Paama's letter of 1878 was not mentioned at this hearing. The Court recommendation was that:

"The Court does not think that any good purpose would be served by returning the island to the Natives, but in view of the position as set out in this report it begs to suggest that some little consideration be shown by the Crown to the Natives interested during consolidation proceedings pending. The Court begs to recommend that the Natives be allowed to continue to use Motukino Island for fishing and bird-nesting and bird-snaring purposes as in the past". (A.J.H.R. 1929: G-6B).

By reference to the Lighthouse Day Journals kept at this time, it is clear the Ngatiwai continued to occupy Fanal and other islands in the group every year in November and December. (Lighthouse Day Journals 1883 - 1981).

In 1941 the islands were gazetted as a prohibited area under the Defense Emergence Regulations 1939. The lighthouse was closed down and an RNZAF base remained in occupation until 1945. (N Z Gazette. 1941: 2033).

The Gazette of 1958 registered Fanal Island (Motukino) as *a* Wildlife Refuge, and in 1961 all the islands in the group, with the exception of Burgess Island (Pokohinu), were declared Wildlife Sancuaries subject to section 6 (2) (a) of the Wildlife Act 1953. This permitted the Ngatiwai to take birds and camp in the Reserve in the course of mutton-birding activities. (N Z Gazette. 1961: 806).

In 1965 and 1966 two internal inquiries, into the status of '. mutton-birding by Māoris on Fanal Island, were carried out by -the Department of Lands and Survey. It was found that the only official status the Ngatiwai had in relation to the islands came from the Court recommendations of 1929. (Department of Lands and Survey file NP39/1 closed file vol. 1).

On 17 February 1966 the issue of copper mininq once more arose. Prospecting on the Hen and Chicken Islands had been suggested; and the Department of Internal Affairs became concerned that Burgess Island was at risk because its status as a Lighthouse Reserve would not ensure protection. The Department proposed that the majority of the island be made a Flora and Fauna Reserve and a small portion only remain for lighthouse purposes. The Marine Division of the Ministry of Transport, who administered Burgess Island, explained that such an arrangements would *be* impractical for their present purposes. (Interdepartmental Correspondence. Department of Lands and Survey file NP39/1 c1osed f i1e vol. 1).

In 1967 the Ngatiwai claimed rights to the Moko Hinau. Islands. Selwyn, Clark, Solicitor, of Warkworth, who was involved in the representation of Māori claims concerning the Te Hapua block: at North Cape; (Murray, 1974) wrote to the Commissioner of Crown Lands informing him that he had been engaged, by the Ngatiwai, to investigate the title of the islands. He had. been unable to find sufficient evidence of the Crowns right to the islands and requested further information - stating that if the matter was not resolved he would refer the case to the Māori Land Court for investigation of title.

Paul Phillips of the Department of Lands and Survey replied to Clark with an abridged history of the land title. He stated that:

"...it is on official record that before European title., the islands were never occupied or used for any length of time by their Māori owners except for spasmodic visits by Māoris from the mainland and Great Barrier Island for fishing, bird-nesting and bird-snaring and cultivation purposes".

Clark was satisfied with the account and notified the Department that his clients would not pursue the matter any further. (Correspondence December 1967. Department of Lands and Survey file NP39/1 closed file vol. 1) .

In 1968, the Department of Internal Affairs made a submission to transfer the Moko Hinau Islands, excluding Burgess- Island, to the Hauraki Gulf Maritime Park. In October of that year the islands, with the exception of Burgess, were made Flora, and Fauna Reserves subject to the 1965 Muttonbirding Order. In December the Department of Internal Affairs notified the Department of Lands and Survey that muttonbirding an the islands was a privilege, not a tribal right, and the Department recommended that the privilege be withdrawn when the islands were made part of the Maritime Park. The Department of Lands and Survey felt that such *a* decision would harm relations with the Ngatiwai; and in consultation with the Aotea Māori Committee, who administered the muttonbirding, it was agreed that tairding would cease on Fanal Island but be permitted to continue on the other islands - excluding Burgess Island. (Interdepartmental correspondence. Department of Lands and Survey file NF'39/1 closed file vol. 1) .

In July 1969 the Moko Hinau. Islands, with the exception of Burgess Island, were gazetted as part of the Hauraki Gulf Maritime Park. Thus, any landing without permits was prohibited. (NZGazette. 1969: 1323).

The Ngatiwai birders, however, continued to land without permits until 1978. A meeting between the Parks Board and the Aotea Māori Committee resolved that:

1) Birders would apply for landing permits each year through the Committee Secretary.

2} Illegal birding by people from outside Aotea would cease.

3) Greater care would be taken to ensure fires lit were safe. x

4) The appointment of an Honorary Ranger was discussed. (Minutes of meeting 1978. Department of Lands and Survey file NP39/1 vol. 2).

In 1979 the Grey-Faced Petrel (Northern Muttonbird) Notice was produced. This notice set a tentative date for the cessation of all birding on the Moko Hinau's as the end of the 1985 season, (Department of Lands and Survey file 9ol. 2).

(The automation of lighthouse was carried out in March 1980 and the remaining keeper removed, pers. obs.)

In March 1981 it was proposed by the Department of Lands and Survey and the Ministry of Transport, that the majority of Burqess Island be declared surplus to requirements, and be made a Public Reserve under the Public Reserves Act 1Q77. Part o-f the section claimed under the Public Works Act 1S76 was also to be declared surplus, it would then be made Crown land under the Land Act 1948 and transferred to the Department of Lands and Survey for $4000. The balance of the land was to remain a government work reserved for Lighthouse purposes. (Report on present status 1981. Department of Lands and Survey file NP39/1 vol. 2).

However, during legal research related to transfer of the surplus land it was realised that under the Public Works Act 1929 any land that became surplus to the use it was originally taken for, had to be offered to the original owners or their descendants. This issue is currently still under investigation by the Department of Lands and Survey and concerns approximately 7.5 hectares of the central part of Burgess Island. (Inter departmental correspondence. Department of Lands and Survey file NP39/1 vol. *2).*

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Appendix 4 i

This document was written by Dr Phil Moore in 2009. It sets out his final view of the physical characteristics of the obsidian collected from the Poor Knights Islands. Dr Moore also facilitated the Auckland University geochemical analysis carried out by J Wilmshurst.

Poor Knights obsidian (paper) **Draft 25/4/09**
By P Moore

PHYSICAL CHARACTERISTICS

Seven main types of obsidian can be distinguished on the basis of physical characteristics, and these types have been placed into four groups (A –D). These groupings are based primarily on colour in transmitted light and translucency, but Group C obsidian is distinguished by the high proportion of crystal inclusions (phenocrysts). Almost every piece of obsidian contains small (<1 mm diameter) yellowish glassy globules as well as some phenocrysts, predominantly of feldspar. Terminology follows that used by Moore (1988).

GROUP A ('Grey to greenish grey')

Type 1
This is the dominant type. Colour in reflected light ranges from dark grey to black, and many pieces are dark grey to greyish black. Translucency is generally moderate to poor, and colour in transmitted light is grey to greenish grey. Flow-banding varies from weak to strong, but is usually moderate to strong, and colour banding (dark grey/greyish black) is common. A few pieces contain very thin brownish black bands (cf. Type 1A).

Spherulites are rare, and restricted to this type. They were identified in only 17 pieces. The spherulites are light grey and mostly 1-2 mm in diameter, but up to 7 mm in one piece. Vesicles (gas bubbles) were recorded in 8 pieces. Several pieces also contain small black crystals, some of which may be biotite mica.

Type1A
This type is rare. It is similar to Type 1, but dark grey to brownish black in colour. Translucency is moderate to poor.

GROUP B ('Brown')

Type 2
This is relatively common. Colour is generally black or dark grey to black. Translucency is usually moderate, and colour in transmitted light is distinctly brownish. Flow banding is generally weak to moderate, with wispy or streaky bands. Some pieces are strongly flow-banded. Slight colour banding (black/dark grey) is common. This type is gradational into Type 3.

Type 3

Uncommon. Colour is black, and translucency moderate to good and the obsidian has a distinct brownish colour in transmitted light. Flow banding is weak. Rare green crystals were recorded in one piece, and biotite? in another.

Type 3A
Very rare. It is the same as Type 3, but has a stronger brown colour in transmitted light, and is usually more translucent.

Type 4
This type is relatively rare. Colour is black, and the obsidian is characterised by poor to very poor translucency; some is almost opaque. It also has a strong moderate brown colour in transmitted light. Flow-banding is generally weak, but a few pieces are strongly banded.

Type 5
There is only 1 flake of this type (# 94), and it was included in this group based on the presence of brown-black globules. It is red (10R 4/6) with black streaks, and has very poor translucency.

GROUP C

Only 5 pieces (4 flakes and 1 core), all from the general collection, were placed in this group. The obsidian is characterised particularly by the presence of common to abundant phenocrysts, along with common globules and generally moderate translucency. It is grey in transmitted light. Flow-banding ranges from weak to strong, and some pieces are colour banded. It is also notable that the 4 flakes have no cortex; the core (10.5) has a rough, slightly water-worn cortex.

The physical characteristics of this group suggest the 5 pieces were either derived from a different source to groups A and B, or represented a variant of the obsidian from the same source.

GROUP D ('Green')

The pieces in this group (7 flakes /pieces, 1 core) all have an olive green colour in transmitted light, a feature which characteristic of material from Mayor Island.

Cortex
The presence of cortex is a distinctive feature of the obsidian in groups A and B. This is generally rough to slightly water worn, and only a few pieces have a smooth water-worn surface. The highest proportion of pieces with cortex is in the general collection (86%), and the lowest percentage is at the Hearth site (44%). Most cobbles and part cobbles/cores have a rough to slightly worn cortex. The nature of this cortex suggests that the obsidian was obtained from a stream or beach environment in relatively close proximity to the original parent (in situ) deposit.

GEOCHEMISTRY
Twenty three pieces were analysed by non-destructive energy-dispersive XRF (EDXRF) using the new portable Innov-X spectrometer at the Anthropology Department, University of Auckland. The pieces were selected from all four groups – 5 from Group A (Type 1), 13 from Group B (6 of Type 2, 3 of Types 3/3A, 3 of Type 4, 1 of Type 5), 3 from Group C and 1 from Group D. One was

either Type 1 or 2. Several reference samples from potential sources were also analysed. All samples were run for 6 minutes, and the data were automatically downloaded onto an iPAQ PDA. A standard (NIST 2709) was run at the start of each session and again after about 8-10 samples. The results are presented in Table 1.

Although the Innov-X routinely measures the concentrations of 25 elements, that does not include the lighter elements of Si, Al, Na and Mg. Detection limits for most elements are 10-100 ppm, and 250-2500 ppm for K and Ca, and precision errors are typically <5%. However measurements of some elements have considerably larger errors and hence they have been excluded from consideration, along with those below detection limits. The elements of greatest value in sourcing obsidian are Rb, Sr and Zr, which have errors of only about 1-3%. Zinc may also be useful in some cases.

The Rb, Sr and Zr values for artefacts in groups A and B (Types 1-5) are very consistent, and clearly indicate that the obsidian in these two groups came from the same source (Table 1). The Sr and Zr values for Group C are quite different, and confirm suspicions from the physical characteristics that the pieces in this group are from a different source. Zinc values are also slightly lower. The composition of the one analysed piece of Group D obsidian differs markedly from that of the other three groups, confirming that it originated from Mayor Island.

Five samples were also analysed by conventional wavelength-dispersive XRF (here simply referred to as XRF) using the Siemens SRS 3000 sequential X-ray spectrometer at the Geology Department, University of Auckland. The same samples had previously been analysed by EDXRF, and represented groups A, B and C. Analysis was by the low dilution fusion method, which involved the preparation of beads of powdered sample mixed with a lanthanum oxide flux in a ratio of 2g of ignited sample to 6g of flux. Sample size ranged from 8 to 14g in weight, and only two of the pieces were completely destroyed. The results are presented in Table 2.

The XRF analyses confirm the results obtained by EDXRF in demonstrating that Types 1-4 have the same composition, with remarkably similar values for Rb, Sr, Y, Zr and Ba, and also most major elements. In contrast, the sample of Group C obsidian has a very different chemistry with significantly lower concentrations of Fe, Na, K, Y, Zr and Ba, and higher Si and Sr values. The Rb value, however, is almost identical to that of Types 1-4.

Plots of the Rb, Sr and Zr values obtained by EDXRF and XRF analysis of the Poor Knights artefacts are shown in Figures 0, 00. Rb, Sr and Zr values for source samples from Te Ahumata, Awana, Fanal Island and Huruiki have also been plotted on these diagrams. These samples were analysed by XRF and/or EDXRF, and in general there is good agreement between the two different types of analyses. The XRF data were obtained as part of a separate project.

It is evident from the Rb versus Sr plot (Fig. 0) that the artefacts form a separate cluster situated between the Fanal Island, Te Ahumata and Awana sources, and that the group A+B artefacts plot in a slightly different position from the Group C obsidian, which is closer to the Fanal Island field. The Poor Knights obsidian obviously did not come from the Huruiki source. A much clearer separation of groups A+B and C is evident on the Zr-Rb plot (Fig. 0), which emphasises the significantly lower Zr values of the latter group. Notably, the one piece of red obsidian (Type 5) plots in the middle of the group A+B cluster. The Zr-Rb plot also clearly demonstrates that Group A + B obsidian definitely did not come from the Te Ahumata source, and almost certainly not from the Awana source either. The Group C samples, however, plot within or adjacent to the Fanal Island field, and there is no doubt that they originated from that source.

SOURCES

Despite the considerable variation in physical characteristics , notably colour in transmitted and reflected light, translucency, and flow-banding, it was considered that groups A and B were obtained from the same source, based mainly on the fact that virtually every piece (regardless of other characteristics) contains yellow glassy globules, and sparse crystals. The nature of the cortex is also similar in groups A and B.

Initial indications were that Huruiki was the most likely source for types 1-4 because of a reasonably close match in certain (but not all) characteristics, notably the presence of yellow glassy globules. Some Huruiki source samples show characteristics similar to Types 1, 2 and possibly 3, but as yet material similar to Type 4 has not been found. The Awana source on Great Barrier could almost certainly be ruled out because of the marginal flake quality of the obsidian from that source. Comparisons with limited reference material from the Te Ahumata source did not provide a good match, and although some samples from this source are similar to Type 3 they do not contain glassy globules.

Flake quality red obsidian is presently known only from a limited number of sources in New Zealand, namely Otoroa, Te Ahumata, Waihi, Mayor Island and Taupo. So far none has been found at Huruiki or on Fanal Island, and therefore it is highly unlikely the one piece of Type 5 obsidian came from either of those sources.

It is evident from the chemical analyses that Huruiki can be completely eliminated as a source for the groups A and B obsidian on the Poor Knights. On the basis of Zr concentrations alone,Te Ahumata can also be ruled out. This indicates that the group A and B obsidian came from an unknown source almost certainly somewhere on Great Barrier Island, although eastern Northland cannot be entirely excluded. The possibility that the obsidian occurs naturally on the Poor Knights, as a ‘lag’ deposit, has to be considered, but available analyses of rhyolite samples from the islands indicate they have very different Sr, Rb and Zr values (Nicholson 1996), making it extremely unlikely the obsidian is of local origin. The slightly water worn cortex present on many pieces also excludes this possibility.

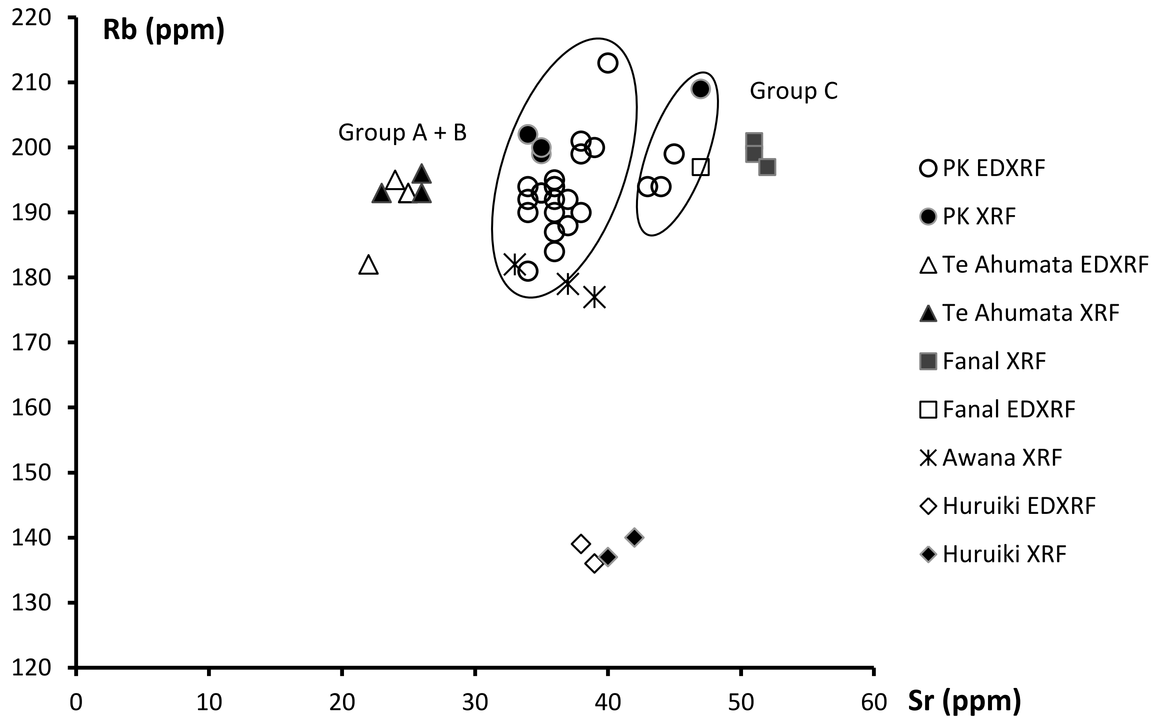


Figure 0: Plot of Rb versus Sr for Poor Knights artefacts and potential sources

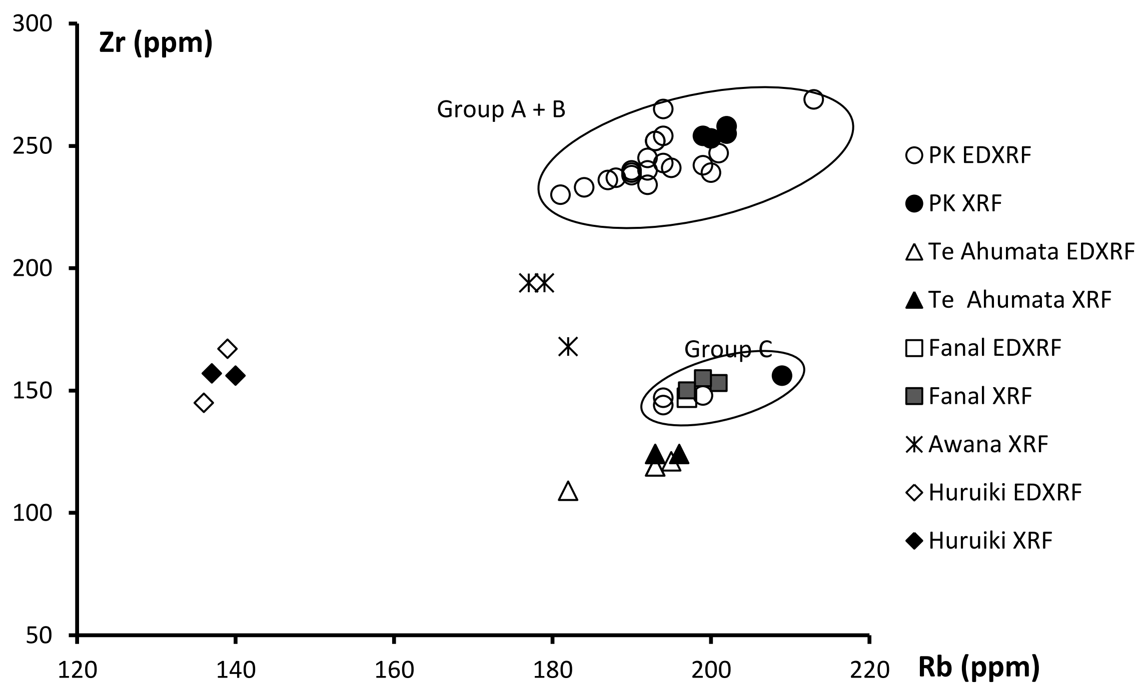


Figure 00: Plot of Zr versus Rb

TABLE 1: EDXRF analyses of Poor Knights artefacts (all concentrations in ppm)

No.	Type/group	Zn	Rb	Sr	Zr
2	**1**	**34**	**200**	**39**	**239**
3	**2**	**33**	**192**	**34**	**240**
10/5 (10*)**	**Group C**	***24***	***194***	***43***	***144***
22	**1**	**35**	**190**	**36**	**239**
24	**3/3A**	**34**	**199**	**38**	**242**
26	**2**	**31**	**190**	**38**	**240**
44a	**2**	**43**	**213**	**40**	**269**
65a/2 (65a/1)**	**1+2**	**31**	**192**	**36**	**234**
68/2	**Group C**	***27***	***199***	***45***	***148***
70	1	35	194	36	254
73b	**2**	**34**	**194**	**34**	**265**
74	**3**	**32**	**193**	**35**	**252**
84a	**4**	**32**	**181**	**34**	**230**
100	**3**	**36**	**201**	**38**	**247**
112	**2**	**29**	**184**	**36**	**233**
115/2 (115)**	**Group C**	***24***	***194***	***44***	***147***
120	**Group D**	***205***	***154***	***4***	***1158***
122/2	**1A?**	**37**	**194**	**36**	**243**
328/1/4 (328/101*)**	1	37	195	36	241
328/1/5 (328/102*)**	2	38	188	37	237
328/1/6 (328/103*)**	4 (3)	31	190	34	238
328/1/7 (328/4*)**	4	31	187	36	236
94	**5**	**32**	**192**	**37**	**245**

*Incorrect original sample number in brackets

**Corrected sample number in brackets

TABLE 2: XRF analyses of Poor Knights artefacts (anhydrous). Analyses by J. Wilmshurst, University of Auckland.

Sample	**PK70**	**PK3**	**PK74**	**PK328/4**	**PK10(5)**
Type	**Type 1**	**Type 2**	**Type 3**	**Type 4**	**Group C**
wt %					
SiO2	73.86	73.78	72.46	72.95	**75.68**
TiO2	0.21	0.21	0.21	0.21	0.18
Al2O3	13.53	13.58	13.28	13.37	**12.74**
Fe2O3	1.76	1.76	1.76	1.75	**1.36**
MnO	0.03	0.03	0.03	0.03	0.02
MgO	0.22	0.23	0.23	0.22	0.24
CaO	0.83	0.84	0.83	0.83	**0.92**
Na2O	4.36	4.37	4.28	4.3	**3.74**
K2O	4.66	4.64	4.62	4.65	**4.47**
P2O5	0.03	0.03	0.03	0.03	0.04
H2O*	0.08	0.07	0.09	0.11	0.09
LOI*	0.26	0.38	0.36	0.42	0.26
Total*	99.61	99.58	97.85	98.47	99.49
(ppm)					
Sc	5	3	6	3	4
V	10	11	11	11	**18**
Cr	3	3	3	2	4
Ni	0	0	0	0	0
Cu	0	0	0	0	0
Zn	39	41	41	40	31
Rb	202	202	199	200	209
Sr	34	34	35	35	**47**
Y	43	43	42	43	**32**
Zr	255	258	254	253	**156**
Nb	11	12	11	12	10
Ba	400	403	409	400	**312**
Pb	23	23	23	25	23

*original values

Appendix 4 ii

The following tables were created by the author to XRF source obsidian from the Poor Knights Islands by comparing them to the University of Otago Anthropology and Archaeology Department comparative obsidian collection.

Modified Kahurangi Tables

These modified Kahurangi tables take Net energy data from the pXRF Bruker machine to create a comparative sourcing template. This was achieved by analyzing 110 samples from the Poor Knights obsidian assemblage and compared to 21 samples from 16 known obsidian sources that cover the four primary volcanic regions in New Zealand.

Using this excel table the net energy of five trace elements (Rb, Sr, Y, Zr and Nb) are compared between known and unknown sources. Specifically, the Kahurangi table measures the percentage difference of these elements between the samples from the 16 known sources and the unknown samples from the Poor Knights Islands. All percentage differences are converted to positive figures then added together to produce a distance measure. The probable source is the one where the resulting distance measure is closest to a known source.

Two levels of exclusion criteria are applied that should exclude dissimilar sources. These are:

3. Using Rb, Sr, Y, Zr and Nb - a known source is excluded when any single trace element value is >60% different from the unknown source.
4. Using only Rb, Sr, and Zr - a known source is excluded when any single trace element value is >60% different from the unknown source.

In each table a representative type of Poor Knights obsidian is compared to known sources. The four nearest distance measures are shown in red and the most likely source area for the sample of Poor Knights obsidian coloured yellow. The four sources with the nearest distance measures are shown on the subsequent page as line graphs where the 'best match' of the identified source is visible pictorially.

James Robinson

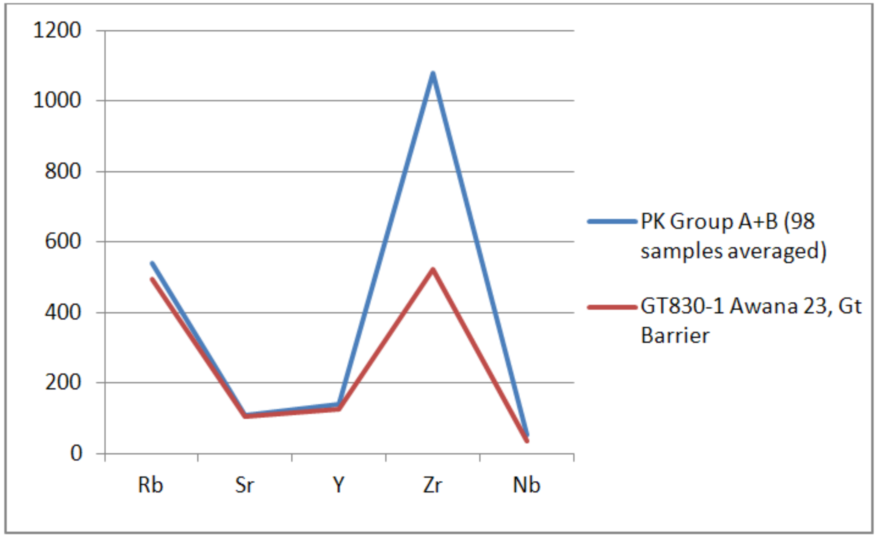
2013

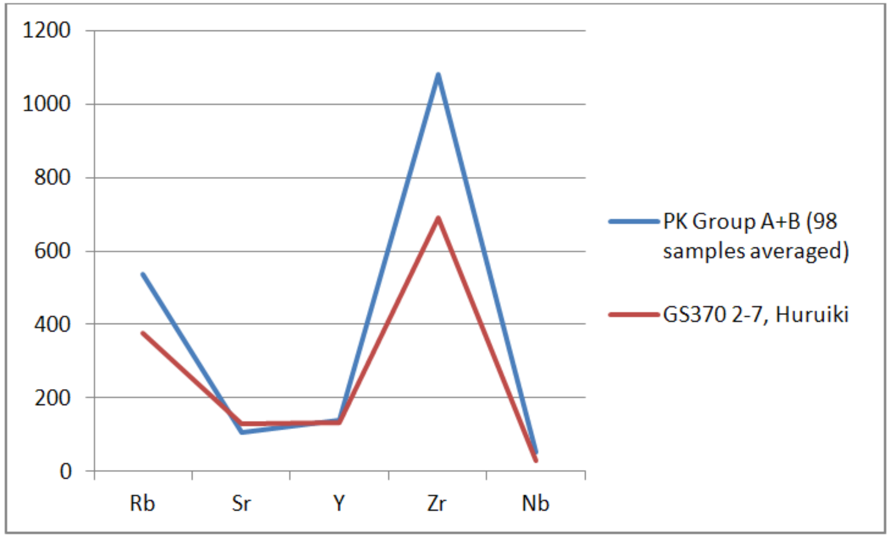
Table A Showing the Bruker XRF NET energy results obtained from the University of Otago obsidian comparative collection compared to the Group A+B source in the Poor Knights obsidian assemblage.

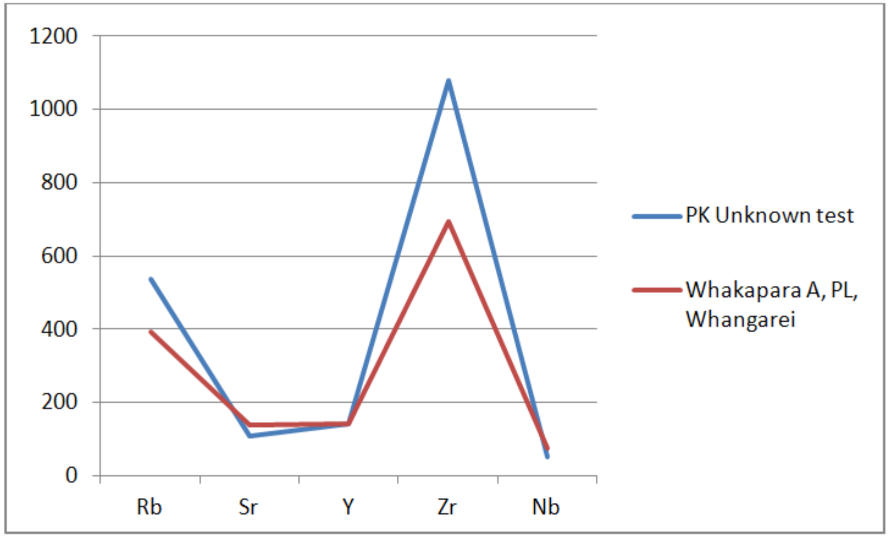
OBSIDIAN SOURCES	ELEMENTS (net energy)					% of net Energy difference of unknown obsidian to known source trace element					SUM of (-)	SUM of (+)	Total % difference	Total%with excluded* sources	Total%with excluded** sources
	Rb	Sr	Y	Zr	Nb	Rb	Sr	Y	Zr	Nb					
Northland Volcanic Region															
GS446 Waiare 26, Kaeo	1589	13	706	8140	1206	195.353	-87.962	400.700	653.703	2175.400	-87.962	3425.230	3513	excluded	excluded
GS560 Pungaere 24 run A, Kaeo	1460	1	725	7654	1113	171.375	-99.074	414.100	608.703	2000.000	-99.074	3194.260	3293	excluded	excluded
Whakapara A, JJR, Whangarei	373	150	177	803	78	-30.669	38.888	25.531	-25.648	47.169	-56.317	111.590	168	168	**95**
Whakapara A, PL, Whangarei	393	140	142	694	75	-26.951	29.629	0.709	-35.740	41.509	-62.692	71.848	135	135	**92**
HU7 GS195A, Huruiki	300	95	86	489	55	-44.237	-12.037	-39.007	-54.722	3.773	-150.004	3.773	154	154	**111**
HU-5 GS 234-A, Huruiki	296	83	82	560	47	-44.981	-23.148	-41.843	-48.148	-11.320	-169.442	0	169	169	**136**
GS370 2-7, Huruiki	377	129	134	690	31	-29.925	19.444	-4.964	-36.111	-41.509	-112.510	19.444	132	**132**	**85**
Coromandel Volcanic Zone															
GS148-1 Te Ahumata, Gt Barrier	507	62	146	473	75	-5.7620	-42.592	3.546	-56.203	41.509	-104.558	45.055	150	150	**105**
GT830-1 Awana 23, Gt Barrier [??]	496	105	126	522	34	-7.8066	-2.777	-10.638	-51.666	-35.849	-108.730	0	109	109	**62**
GT850 Site 33 Fanal, Mokohinau Is	522	152	90	690	53	-2.973	40.740	-36.170	-36.111	0	-75.255	40.740	116	116	**80**
GT844 Purangi 31 run a, Coromandel	323	198	102	550	37	-39.962	83.333	-27.659	-49.074	-30.188	-146.885	83.333	230	excluded	excluded
GT847 Maratoto 32 run a, Coromandel	460	98	110	355	78	-14.498	-9.259	-21.985	-67.129	47.169	-112.872	47.169	160	excluded	excluded
Whangamata RO-16 GT476 run a	409	213	120	491	33	-23.977	97.222	-14.893	-54.537	-37.735	-131.144	97.222	228	excluded	excluded
Waihi GT843, Coromandel	368	495	12	531	34	-46.195	358.333	-91.489	-50.833	-35.849	-224.367	358.333	583	excluded	excluded
Tairua GS631, Coromandel	328	366	58	770	38	-39.033	238.888	-58.865	-28.703	-28.301	-154.904	238.888	394	excluded	excluded
Tairua GS629 run a, Coromandel	342	316	83	841	47	-36.431	192.592	-41.134	-22.129	-11.320	-111.016	192.592	304	excluded	excluded
Tairua GS629 run b, Coromandel	332	378	99	799	53	-38.289	250.000	-29.787	-26.018	0	-94.095	250	344	excluded	excluded
Hahei HA41-L21a, Coromandel	334	226	141	675	66	-37.918	109.259	0	-37.500	24.528	-75.418	133.787	209	excluded	excluded
Taupo Region															
ON-33 run-a Ongaroto GT355	417	281	64	574	44	-22.490	160.185	-54.609	-46.851	-20.454	-144.407	160.185	305	excluded	excluded
MA-37 run-a Maraetai GT282	390	309	70	544	49	-27.509	186.111	-50.350	-49.629	-7.547	-135.040	186.111	321	excluded	excluded
RO-14 run-a Whakarewarewa GT18	400	237	81	726	47	-25.650	119.444	-42.553	-32.777	-11.320	-112.302	119.444	232	excluded	excluded
Mayor Island															
MI-1 Mayor Island	349	21	395	4192	308	-35.130	-80.555	180.141	288.148	481.132	-115.685	949.422	1065	excluded	excluded
UNKNOWN															
Group A+B (98 sample average)	**538**	**108**	**141**	**1080**	**53**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		

Excluded* = Using only Rb, Sr, Y, Zr and Nb - a source is excluded when any single trace element value is >60% different from the unknown source.

Excluded = Using only Rb, Sr, and Zr - a source is excluded when any single trace element value is >60% different from the unknown source.**







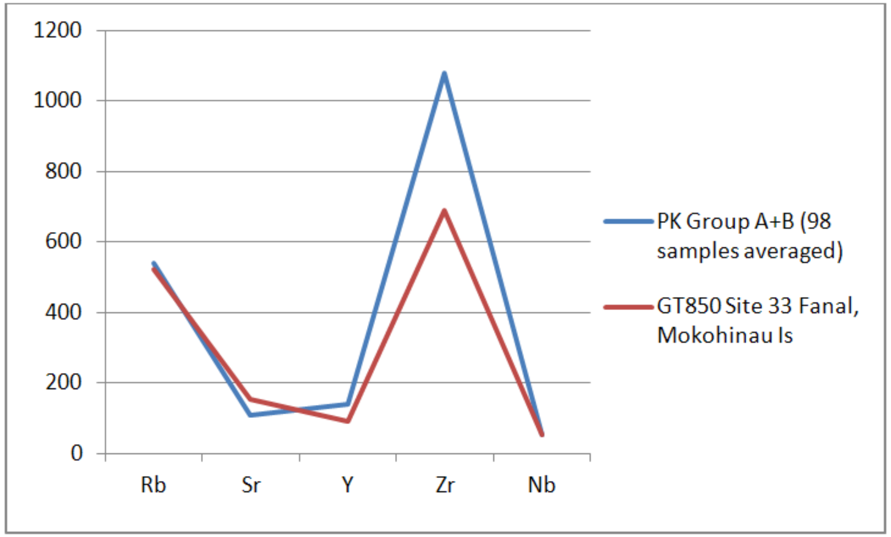


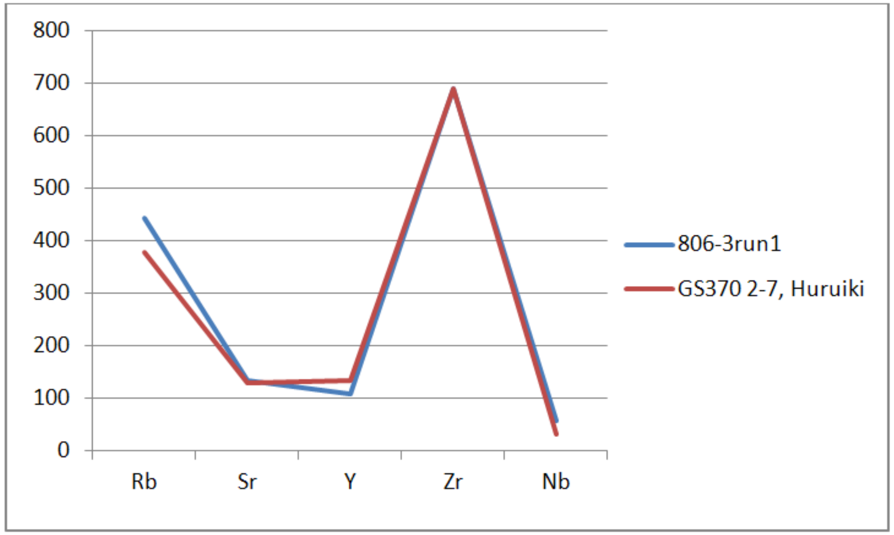
Table A comment:
Using the larger elements [Rb, Zr] only Awana has the nearest match however the 51% difference on the Zk element suggests that although this may be a related source it is NOT the actual source.

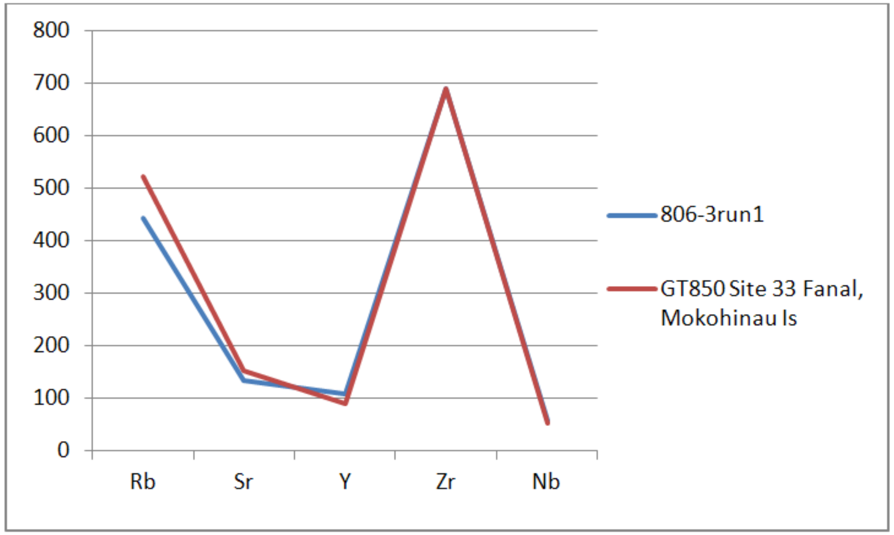
Table B Showing the Bruker XRF NET energy results obtained from the University of Otago obsidian comparative collection compared to sample 806-3 run 1 in the Poor Knight obsidian assemblage.

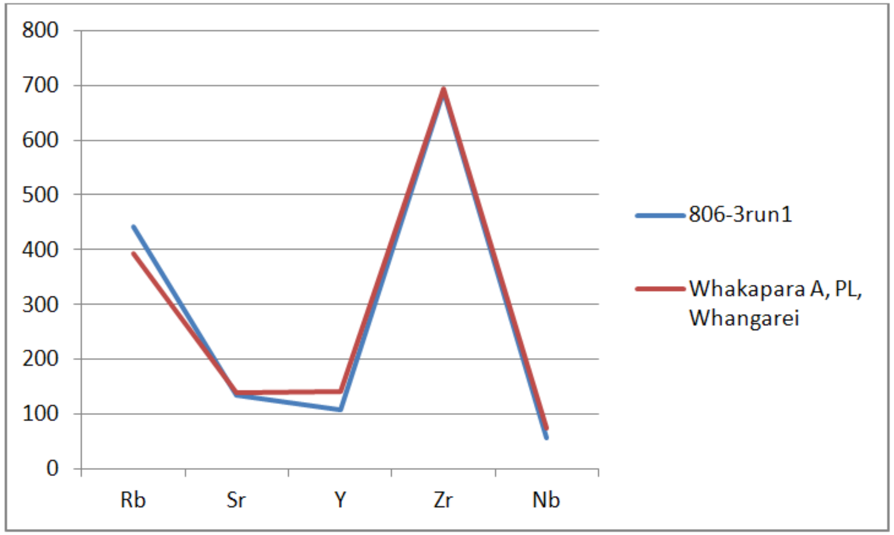
OBSIDIAN SOURCES	ELEMENTS (net energy)					% of net Energy difference of unknown obsidian to known source trace element					SUM of (-)	SUM of (+)	Total % difference	Total%with excluded* sources	Total%with excluded** sources
	Rb	Sr	Y	Zr	Nb	Rb	Sr	Y	Zr	Nb					
Northland Volcanic Region															
GS446 Waiare 26, Kaeo	1589	13	706	8140	1206	259.502	-90.298	553.703	1081.422	2015.789	-90.298	3910.417	4000.716	excluded	excluded
GS560 Pungaere 24 run A, Kaeo	1460	1	725	7654	1113	230.316	-99.253	571.296	1010.885	1852.631	-99.253	3665.129	3764.383	excluded	excluded
hakapara A, JJR, Whangarei	373	150	177	803	78	-15.610	11.940	63.888	16.545	36.842	-15.610	129.217	144.827	excluded	44
Whakapara A, PL, Whangarei	393	140	142	694	75	-11.085	4.477	31.481	0.725	31.578	-11.085	68.263	79.349	79	16
HU7 GS195A, Huruiki	300	95	86	489	55	-32.126	-29.104	-20.370	-29.027	-3.508	-114.137	0	114.137	114	89
HU-5 GS 234-A, Huruiki	296	83	82	560	47	-33.031	-38.059	-24.074	-18.722	-17.543	-131.432	0	131.432	131	90
GS370 2-7, Huruiki	377	129	134	690	31	-14.705	-3.731	24.074	0.145	-45.614	-64.051	24.219	88.270	88	**19**
Coromandel Volcanic Zone															
GS148-1 Te Ahumata, Gt Barrier	507	62	146	473	75	14.705	-53.731	35.185	-31.349	31.578	-85.081	81.470	166.551	167	100
GT830-1 Awana 23, Gt Barrier	496	105	126	522	34	12.217	-21.641	16.666	-24.238	-40.350	-86.230	28.883	115.114	115	58
GT850 Site 33 Fanal, Mokohinau Is	522	152	90	690	53	18.099	13.432	-16.666	0.145	-7.017	-23.684	31.677	55.361	55	31
GT844 Purangi 31 run a, Coromandel	323	198	102	550	37	-26.923	47.761	-5.555	-20.174	-35.087	-87.740	47.761	135.501	136	95
GT847 Maratoto 32 run a, Coromandel	460	98	110	355	78	4.072	-26.865	1.851	-48.476	36.842	-75.341	42.766	118.108	118	79
Whangamata RO-16 GT476 run a	409	213	120	491	33	-7.466	58.955	11.111	-28.737	-42.105	-78.308	70.066	148.374	148	95
Waihi GT843, Coromandel	368	495	12	531	34	-20.108	269.402	-88.888	-22.931	-40.350	-172.280	269.402	441.683	excluded	excluded
Tairua GS631, Coromandel	328	366	58	770	38	-25.791	173.134	-46.296	11.756	-33.333	-105.421	184.890	290.311	excluded	excluded
Tairua GS629 run a, Coromandel	342	316	83	841	47	-22.624	135.820	-23.148	22.060	-17.543	-63.316	157.881	221.198	excluded	excluded
Tairua GS629 run b, Coromandel	332	378	99	799	53	-24.886	182.089	-8.333	15.965	-7.017	-40.237	198.054	238.292	excluded	excluded
Hahei HA41-L21a, Coromandel	334	226	141	675	66	-24.434	68.656	30.555	-2.031	15.789	-26.466	115.001	141.468	excluded	excluded
Taupo Region															
ON-33 run-a Ongaroto GT355	417	281	64	574	44	-5.656	109.701	-40.740	-16.690	-29.545	-92.633	109.701	202.334	excluded	excluded
MA-37 run-a Maraetai GT282	390	309	70	544	49	-11.764	130.597	-35.185	-21.044	-14.035	-82.029	130.597	212.626	excluded	excluded
RO-14 run-a Whakarewarewa GT18	400	237	81	726	47	-9.502	76.865	-25	5.370	-17.543	-52.046	82.235	134.281	excluded	92
Mayor Island															
MI-1 Mayor Island	349	21	395	4192	308	-21.040	-84.328	265.740	508.417	440.350	-105.369	1214.509	1319.878	excluded	excluded
UNKNOWN															
Group Unknown 1: 806-3run1	442	134	108	689	57	0	0	0	0	0	0	0	0		

Excluded* = Using only Rb, Sr, Y, Zr and Nb - a source is excluded when any single trace element value is >60% different from the unknown source.

Excluded = Using only Rb, Sr, and Zr - a source is excluded when any single trace element value is >60% different from the unknown source.**







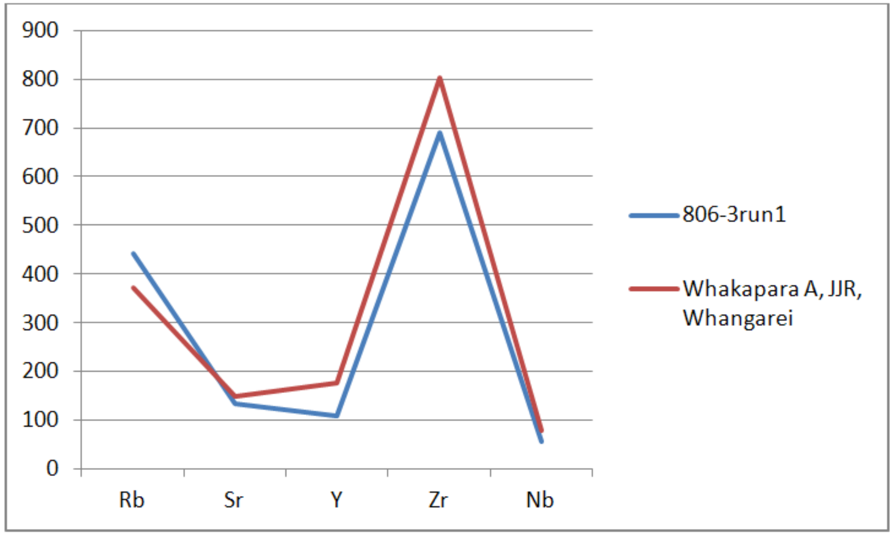


Table B comment:

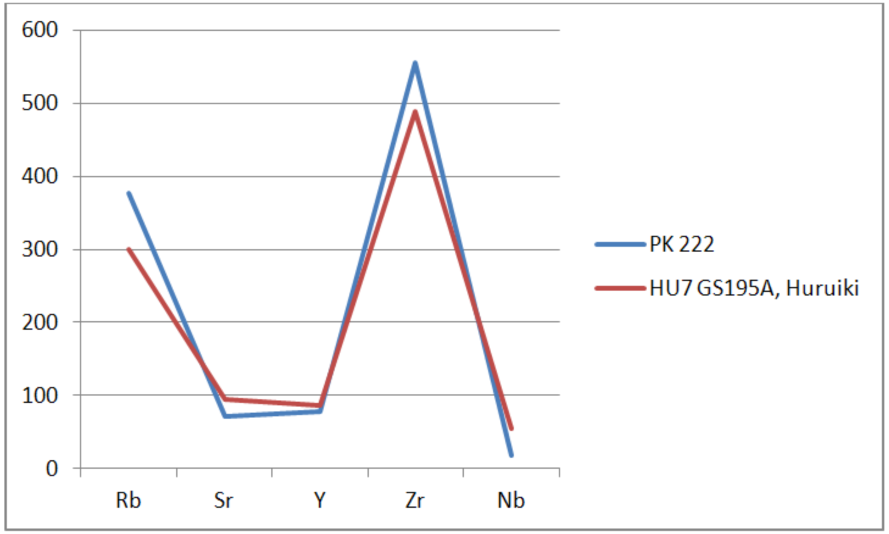
Relatively close match to both Huruiki and Fanal sources. Physical characteristics such as a lack of inclusions suggests that Huruiki rather than Fanal is the most likely source.

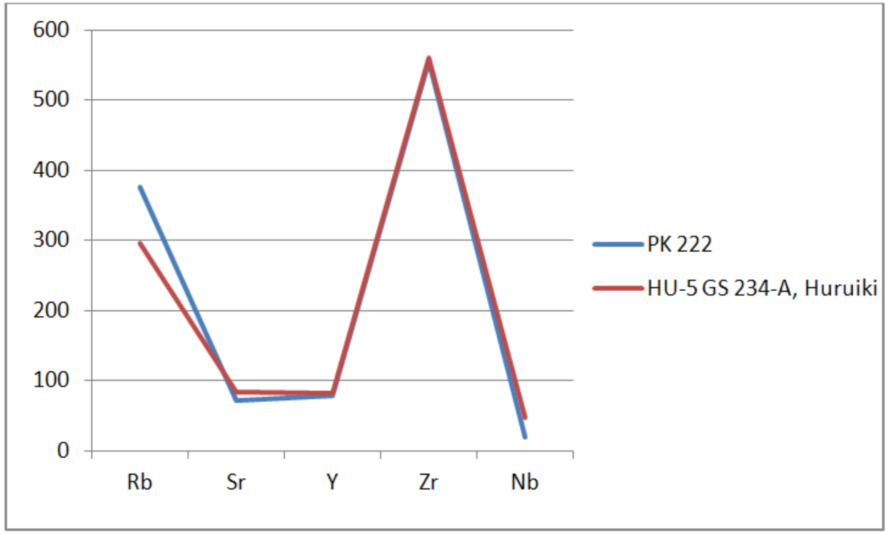
Table C Showing the Bruker XRF NET energy results obtained from the University of Otago obsidian comparative collection compared to sample 222 run 2 in the Poor Knights obsidian assemblage.

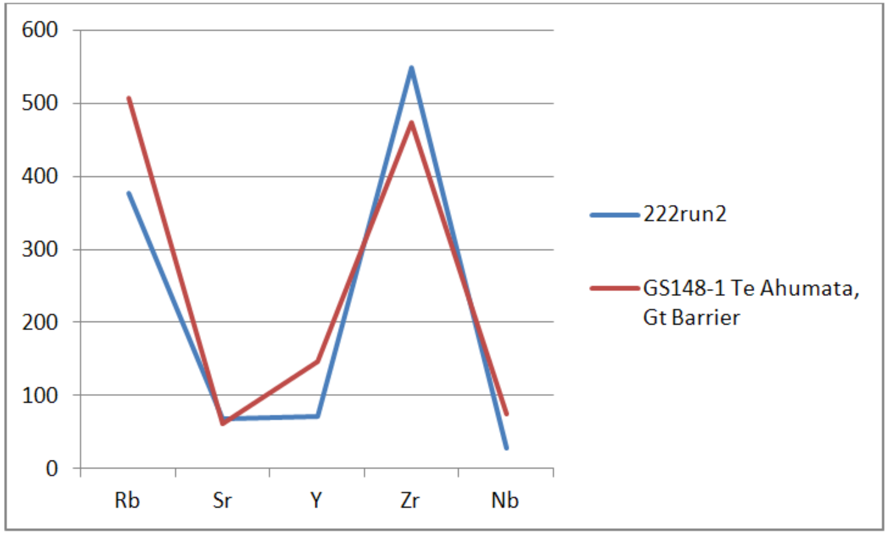
OBSIDIAN SOURCES	ELEMENTS (net energy)					% of net Energy difference of unknown obsidian to known source trace element					SUM of (-)	SUM of (+)	Total % difference	Total%with excluded* sources	Total%with excluded** sources
	Rb	Sr	Y	Zr	Nb	Rb	Sr	Y	Zr	Nb					
Northland Volcanic Region															
GS446 Waiare 26, Kaeo	1589	13	706	8140	1206	321.485	-80.882	894.366	1385.401	4207.142	-80.882	6808.395	6889.278	excluded	excluded
GS560 Pungaere 24 run A, Kaeo	1460	1	725	7654	1113	287.267	-98.529	921.126	1296.715	3875	-98.529	6380.109	6478.639	excluded	excluded
Whakapara A, JJR, Whangarei	373	150	177	803	78	-1.061	120.588	149.295	46.532	178.571	-1.061	494.988	496.0492	excluded	excluded
Whakapara A, PL, Whangarei	393	140	142	694	75	4.244	105.882	100	26.642	167.857	0	404.625	404.625	excluded	excluded
HU7 GS195A, Huruiki	300	95	86	489	55	-20.424	39.705	21.126	-10.766	96.428	-31.190	157.261	188.452	excluded	71
HU-5 GS 234-A, Huruiki	296	83	82	560	47	-21.485	22.058	15.492	2.189	67.857	-21.485	107.598	129.084	excluded	**46**
GS370 2-7, Huruiki	377	129	134	690	31	0	89.705	88.732	25.912	10.714	0	215.064	215.064	excluded	excluded
Coromandel Volcanic Zone															
GS148-1 Te Ahumata, Gt Barrier	507	62	146	473	75	34.482	-8.823	105.633	-13.686	167.857	-22.509	307.973	330.483	excluded	57
GT830-1 Awana 23, Gt Barrier	496	105	126	522	34	31.564	54.411	77.464	-4.744	21.4285	-4.744	184.870	189.614	excluded	91
GT850 Site 33 Fanal, Mokohinau Is	522	152	90	690	53	38.461	123.529	26.760	25.912	89.285	0	303.949	303.949	excluded	excluded
GT844 Purangi 31 run a, Coromandel	323	198	102	550	37	-14.323	191.176	43.661	0.364	32.142	-14.323	267.346	281.669	excluded	excluded
GT847 Maratoto 32 run a, Coromandel	460	98	110	355	78	22.0159	44.117	54.929	-35.218	178.571	-35.218	299.634	334.853	excluded	101
Whangamata RO-16 GT476 run a	409	213	120	491	33	8.488	213.235	69.014	-10.401	17.857	-10.401	308.594	318.996	excluded	excluded
Waihi GT843, Coromandel	368	495	12	531	34	-2.445	627.941	-83.098	-3.102	21.428	-88.646	649.369	738.016	excluded	excluded
Tairua GS631, Coromandel	328	366	58	770	38	-12.997	438.235	-18.309	40.510	35.714	-31.307	514.460	545.767	excluded	excluded
Tairua GS629 run a, Coromandel	342	316	83	841	47	-9.283	364.705	16.901	53.467	67.857	-9.283	502.931	512.215	excluded	excluded
Tairua GS629 run b, Coromandel	332	378	99	799	53	-11.936	455.882	39.436	45.802	89.285	-11.936	630.407	642.343	excluded	excluded
Hahei HA41-L21a, Coromandel	334	226	141	675	66	-11.405	232.352	98.591	23.175	135.714	-11.405	489.833	501.239	excluded	excluded
Taupo Region															
ON-33 run-a Ongaroto GT355	417	281	64	574	44	10.610	313.235	-9.859	4.744	36.363	-9.859	364.953	374.812	excluded	excluded
MA-37 run-a Maraetai GT282	390	309	70	544	49	3.448	354.411	-1.408	-0.729	75	-2.138	432.860	434.998	excluded	excluded
RO-14 run-a Whakarewarewa GT18	400	237	81	726	47	6.100	248.529	14.084	32.481	67.857	0	369.053	369.053	excluded	excluded
Mayor Island															
MI-1 Mayor Island	349	21	395	4192	308	-7.427	-69.117	456.338	664.963	1000	-76.544	2121.301	2197.846	excluded	excluded
UNKNOWN															
Group Unknown 1: 222run2	377	68	71	548	28	0	0	0	0	0	0	0	0		0

Excluded* = Using only Rb, Sr, Y, Zr and Nb - a source is excluded when any single trace element value is >60% different from the unknown source.

Excluded** = Using only Rb, Sr, and Zr - a source is excluded when any single trace element value is >60% different from the unknown source.







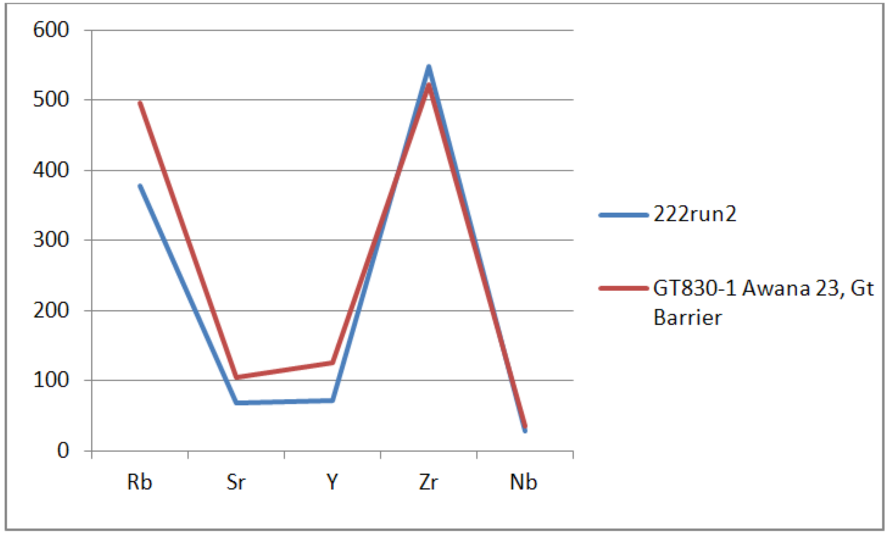


Table C comment:

Close match to two of the Huruiki sources. Of these HU-5 GS234-A Huruiki source is the most likely match.

Table D Showing the Bruker XRF NET energy results obtained from the University of Otago obsidian comparative collection compared to 3 x Group C (average) in the Poor Knights obsidian assemblage.

OBSIDIAN SOURCES	ELEMENTS (net energy)					% of net Energy difference of unknown obsidian to known source trace element					SUM of (-)	SUM of (+)	Total % difference	Total%with excluded* sources	Total%with excluded** sources
	Rb	Sr	Y	Zr	Nb	Rb	Sr	Y	Zr	Nb					
Northland Volcanic Region															
GS446 Waiare 26, Kaeo	1589	13	706	8140	1206	192.633	-91.925	524.778	1046.478	2312	-91.925	4075.891	4167.816	excluded	excluded
GS560 Pungaere 24 run A, Kaeo	1460	1	725	7654	1113	168.876	-99.378	541.592	978.028	2126	-99.378	3814.497	3913.876	excluded	excluded
Whakapara A, JJR, Whangarei	373	150	177	803	78	-31.307	-6.8324	56.637	13.098	56	-38.139	125.735	163.875	164	51
Whakapara A, PL, Whangarei	393	140	142	694	75	-27.624	-13.043	25.663	-2.2533	50	-42.921	75.663	118.585	119	43
HU7 GS195A, Huruiki	300	95	86	489	55	-44.751	-40.993	-23.893	-31.126	10	-140.765	10	150.765	151	117
HU-5 GS 234-A, Huruiki	296	83	82	560	47	-45.488	-48.447	-27.433	-21.126	-6	-148.495	0	148.495	148	115
GS370 2-7, Huruiki	377	129	134	690	31	-30.570	-19.87	18.584	-2.816	-38	-91.263	18.584	109.847	110	53
Coromandel Volcanic Zone															
GS148-1 Te Ahumata, Gt Barrier	507	62	146	473	75	-6.6295	-61.490	29.203	-33.380	50	-101.500	79.203	180.704	excluded	101
GT830-1 Awana 23, Gt Barrier	496	105	126	522	34	-8.655	-34.782	11.504	-26.478	-32	-101.917	11.504	113.421	113	70
GT850 Site 33 Fanal, Mokohinau Is	522	152	90	690	53	-3.8671	-5.590	-20.353	-2.816	6	-32.628	6	38.628	**39**	**13**
GT844 Purangi 31 run a, Coromandel	323	198	102	550	37	-40.515	22.9816	-9.734	-22.535	-26	-98.785	22.981	121.766	122	90
GT847 Maratoto 32 run a, Coromandel	460	98	110	355	78	-15.285	-39.130	-2.654	-50	56	-107.070	56	163.070	163	104
Whangamata RO-16 GT476 run a	409	213	120	491	33	-24.677	32.2985	6.194	-30.845	-34	-89.522	38.492	128.015	128	88
Waihi GT843, Coromandel	368	495	12	531	34	-47.554	207.453	-89.380	-25.211	-32	-194.146	207.453	401.599	excluded	excluded
Tairua GS631, Coromandel	328	366	58	770	38	-39.594	127.329	-48.672	8.4503	-24	-112.267	135.779	248.047	excluded	excluded
Tairua GS629 run a, Coromandel	342	316	83	841	47	-37.016	96.273	-26.548	18.450	-6	-69.565	114.723	184.289	excluded	excluded
Tairua GS629 run b, Coromandel	332	378	99	799	53	-38.858	134.782	-12.389	12.535	6	-51.247	153.317	204.565	excluded	excluded
Hahei HA41-L21a, Coromandel	334	226	141	675	66	-38.489	40.3721	24.778	-4.9296	32	-43.419	97.151	140.570	141	82
Taupo Region															
ON-33 run-a Ongaroto GT355	417	281	64	574	44	-23.204	74.534	-43.362	-19.154	-13.636	-99.358	74.534	173.892	excluded	excluded
MA-37 run-a Maraetai GT282	390	309	70	544	49	-28.176	91.925	-38.053	-23.380	-2	-91.610	91.925	183.535	excluded	excluded
RO-14 run-a Whakarewarewa GT18	400	237	81	726	47	-26.335	47.204	-28.318	2.253	-6	-60.653	49.458	110.112	excluded	excluded
Mayor Island															
MI-1 Mayor Island	349	21	395	4192	308	-35.727	-86.956	249.557	490.422	516	-122.683	1255.980	1378.664	excluded	excluded
UNKNOWN															
3 x Group C (average)	543	161	113	710	50	0	0	0	0	0	0	0	0		

Excluded* = Using only Rb, Sr, Y, Zr and Nb - a source is excluded when any single trace element value is >60% different from the unknown source

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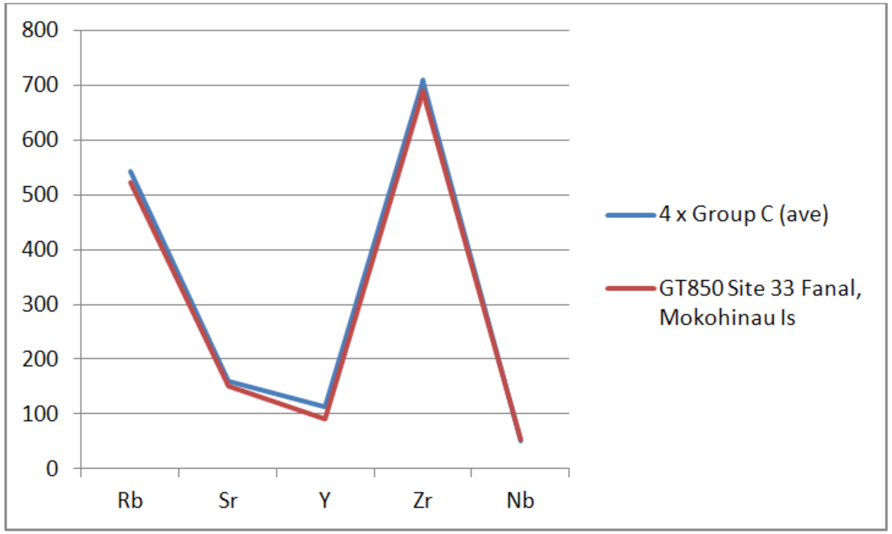
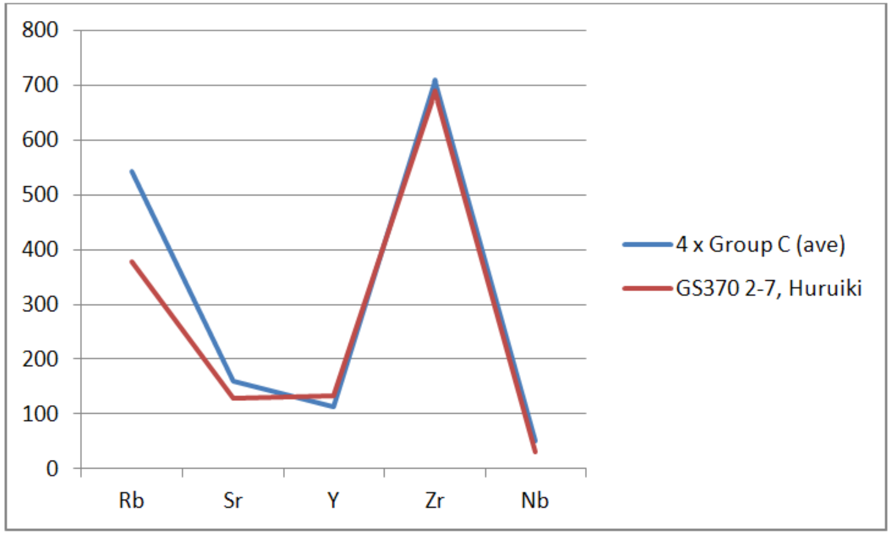
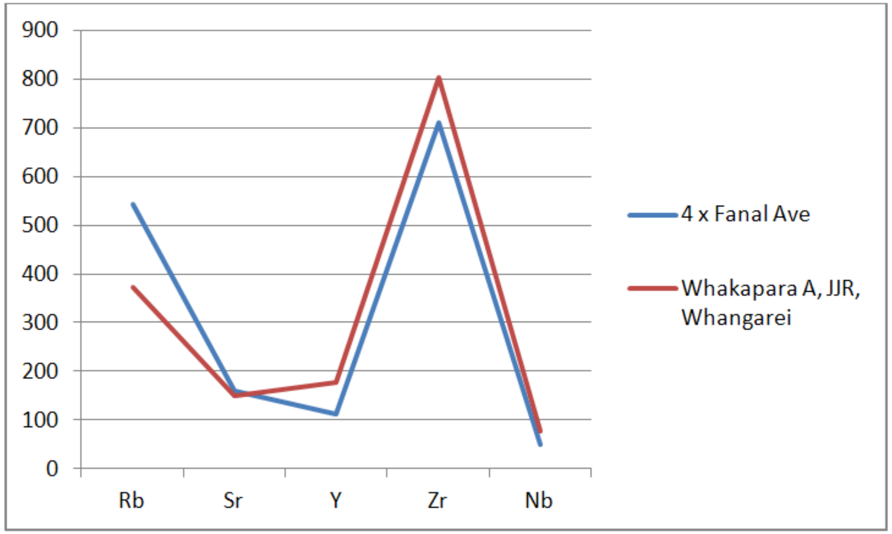






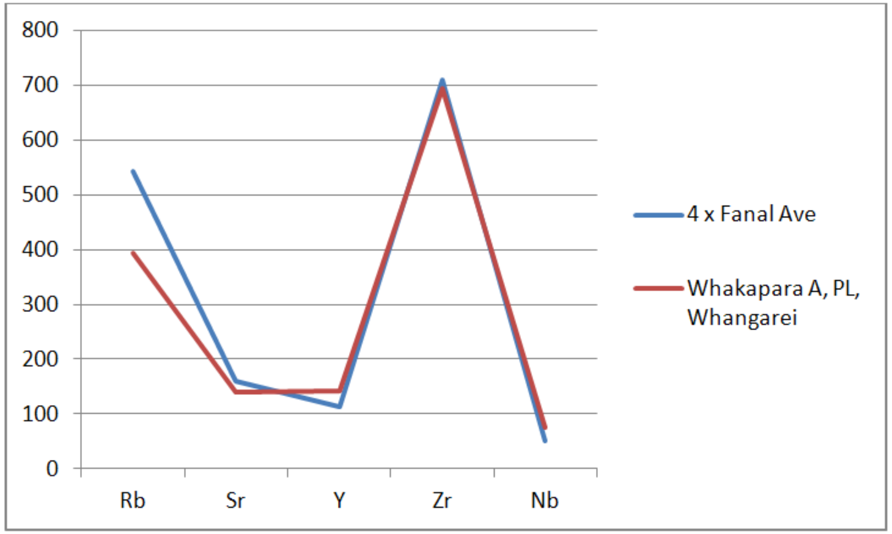


Table D comment:

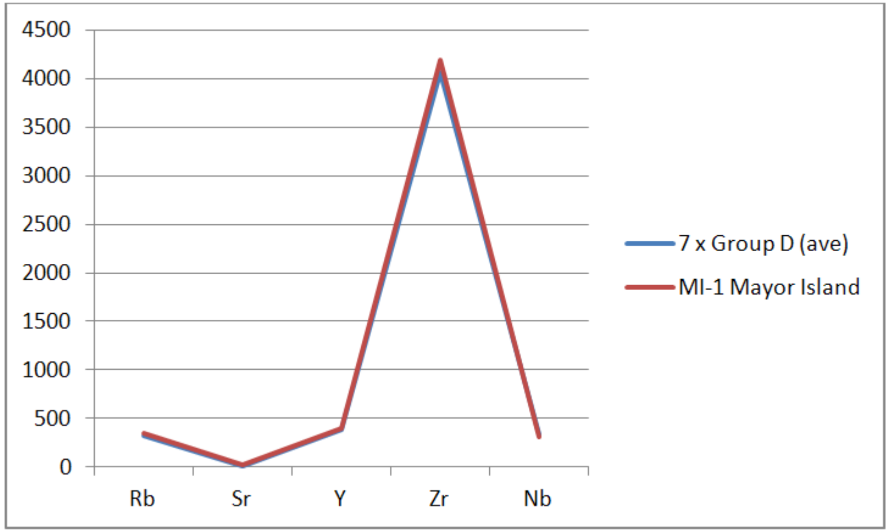
Confirmed match to the Fanal source.

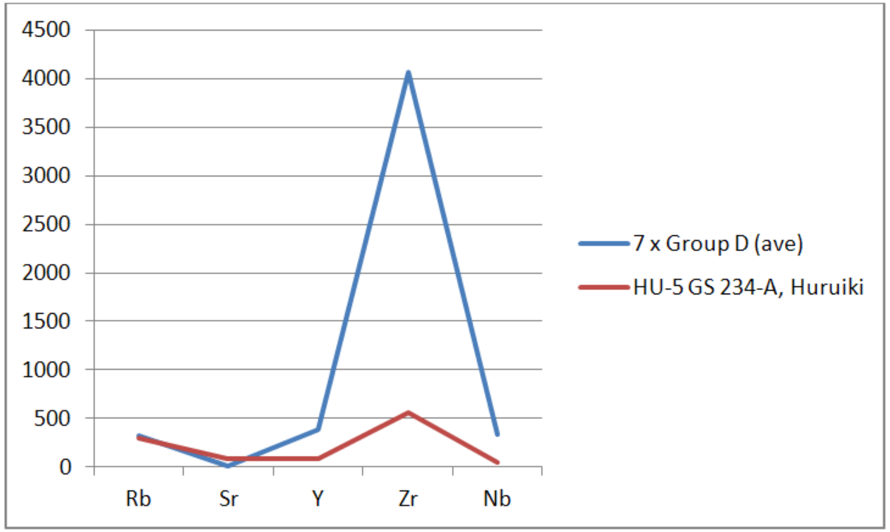
Table E Showing the Bruker XRF NET energy results obtained from the University of Otago obsidian comparative collection compared to sample 7 x Group D (average) in the Poor Knights obsidian assemblage.

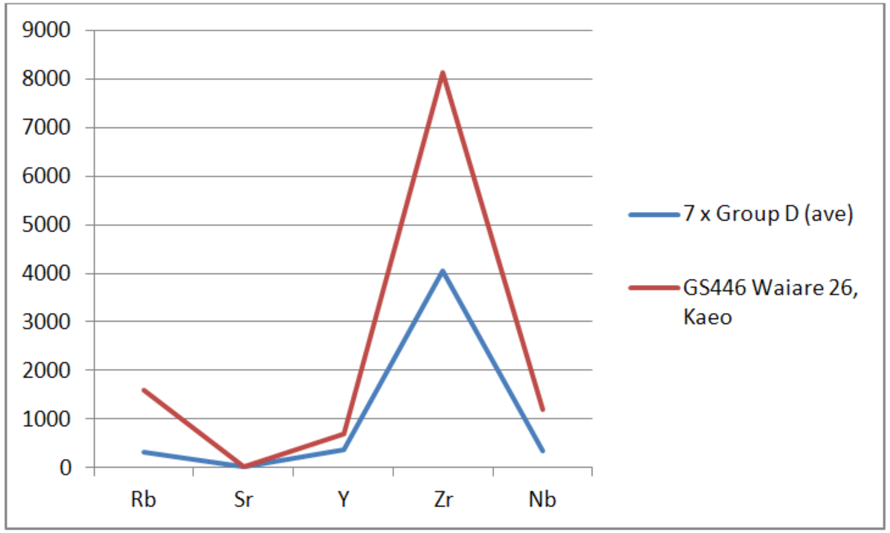
OBSIDIAN SOURCES	ELEMENTS (net energy)					% of net Energy difference of unknown obsidian to known source trace element					SUM of (-)	SUM of (+)	Total % difference	Total%with excluded* sources	Total%with excluded** sources
	Rb	Sr	Y	Zr	Nb	Rb	Sr	Y	Zr	Nb					
Northland Volcanic Region															
GS446 Waiare 26, Kaeo	1589	13	706	8140	1206	384.451	8.3333	83.376	100.344	258.928	0	835.434	835.434	excluded	393
GS560 Pungaere 24 run A, Kaeo	1460	1	725	7654	1113	345.121	-91.666	88.311	88.382	231.25	-91.666	753.066	844.733	excluded	525
Whakapara A, JJR, Whangarei	373	150	177	803	78	13.719	1150	-54.025	-80.236	-76.785	-211.047	1163.719	1374.767	excluded	1244
Whakapara A, PL, Whangarei	393	140	142	694	75	19.817	1066.666	-63.116	-82.919	-77.678	-223.714	1086.483	1310.198	excluded	1169
HU7 GS195A, Huruiki	300	95	86	489	55	-8.536	691.666	-77.662	-87.964	-83.630	-257.794	691.666	949.461	excluded	788
HU-5 GS 234-A, Huruiki	296	83	82	560	47	-9.756	591.666	-78.701	-86.217	-86.01	-260.686	591.666	852.353	excluded	787
GS370 2-7, Huruiki	377	129	134	690	31	14.939	975	-65.194	-83.017	-90.773	-238.986	989.939	1228.925	excluded	1073
Coromandel Volcanic Zone															
GS148-1 Te Ahumata, Gt Barrier	507	62	146	473	75	54.573	416.666	-62.077	-88.358	-77.678	-228.114	471.239	699.354	excluded	559
GT830-1 Awana 23, Gt Barrier	496	105	126	522	34	51.219	775	-67.272	-87.152	-89.880	-244.306	826.219	1070.525	excluded	914
GT850 Site 33 Fanal, Mokohinau Is	522	152	90	690	53	59.146	1166.666	-76.623	-83.017	-84.226	-243.867	1225.813	1469.680	excluded	1309
GT844 Purangi 31 run a, Coromandel	323	198	102	550	37	-1.524	1550	-73.506	-86.463	-88.988	-250.482	1550	1800.482	excluded	1638
GT847 Maratoto 32 run a, Coromandel	460	98	110	355	78	40.243	716.666	-71.428	-91.262	-76.785	-239.476	756.910	996.387	excluded	848
Whangamata RO-16 GT476 run a	409	213	120	491	33	24.695	1675	-68.831	-87.915	-90.178	-246.925	1699.695	1946.620	excluded	1788
Waihi GT843, Coromandel	368	495	12	531	34	10.869	4025	-96.883	-86.930	-89.880	-273.694	4035.869	4309.564	excluded	4124
Tairua GS631, Coromandel	328	366	58	770	38	0	2950	-84.935	-81.048	-88.690	-254.674	2950	3204.674	excluded	3032
Tairua GS629 run a, Coromandel	342	316	83	841	47	4.268	2533.333	-78.441	-79.301	-86.011	-243.754	2537.601	2781.356	excluded	2615
Tairua GS629 run b, Coromandel	332	378	99	799	53	1.219	3050	-74.285	-80.334	-84.226	-238.846	3051.219	3290.066	excluded	3131
Hahei HA41-L21a, Coromandel	334	226	141	675	66	1.8293	1783.333	-63.376	-83.386	-80.357	-227.120	1785.162	2012.283	excluded	1868
Taupo Region															
ON-33 run-a Ongaroto GT355	417	281	64	574	44	27.134	2241.666	-83.376	-85.872	-663.636	-832.885	2268.800	3101.686	excluded	2255
MA-37 run-a Maraetai GT282	390	309	70	544	49	18.902	2475	-81.818	-86.610	-85.416	-253.845	2493.902	2747.748	excluded	2582
RO-14 run-a Whakarewarewa GT18	400	237	81	726	47	21.951	1875	-78.961	-82.131	-86.011	-247.104	1896.951	2144.055	excluded	1880
Mayor Island															
MI-1 Mayor Island	349	21	395	4192	308	6.402	75	2.597	3.174	-8.333	-8.333	87.174	95.508	**96**	**85**
UNKNOWN 7 x Group D (average)	328	12	385	4063	336	0	0	0	0	0	0	0	0		0

Excluded* = Using only Rb, Sr, Y, Zr and Nb - a source is excluded when any single trace element value is >60% different from the unknown source.

Excluded = Using only Rb, Sr, and Zr - a source is excluded when any single trace element value is >60% different from the unknown source.**







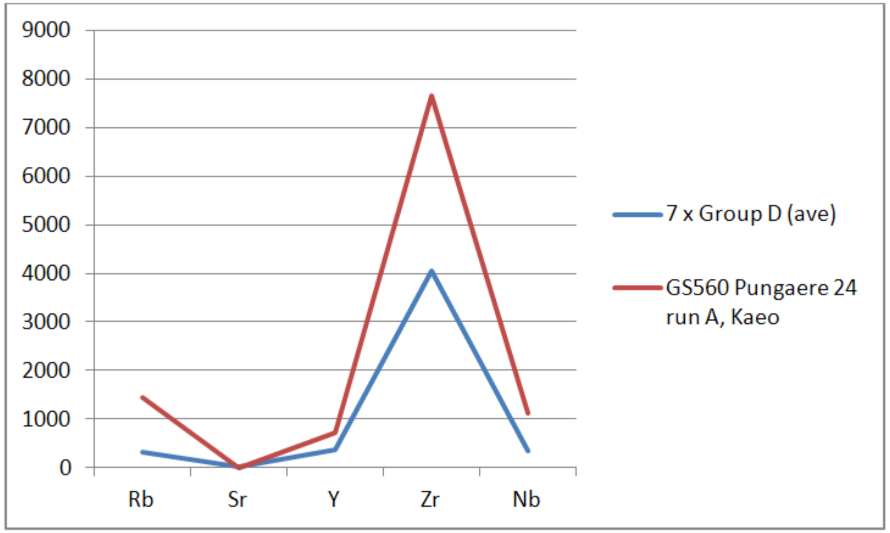


Table E comment:
Confirmed match to Mayor Island source only. Order of magnitude difference to other sources especially due to the Zr and very low Sr NET element counts.

Table F Showing the Bruker XRF NET energy results obtained from the University of Otago obsidian comparative collection compared to sample 13-1 run 1&2 in the Poor Knights obsidian assemblage.

OBSIDIAN SOURCES	ELEMENTS (net energy)					% of net Energy difference of unknown obsidian to known source trace element					SUM of (-)	SUM of (+)	Total % difference	Total%with excluded* sources	Total%with excluded** sources
	Rb	Sr	Y	Zr	Nb	Rb	Sr	Y	Zr	Nb					
Northland Volcanic Region															
GS446 Waiare 26, Kaeo	1589	13	706	8140	1206	184.767	-85.393	460.317	1333.098	1673.529	-85.393	3651.712	3737.105	excluded	2603
GS560 Pungaere 24 run A, Kaeo	1460	1	725	7654	1113	161.648	-98.876	475.396	1247.535	1536.764	-98.876	3421.345	3520.221	excluded	1508
Whakapara A, JJR, Whangarei	373	150	177	803	78	-33.154	68.539	40.476	41.373	14.705	-33.154	165.094	198.248	excluded	143
Whakapara A, PL, Whangarei	393	140	142	694	75	-29.569	57.303	12.698	22.183	10.294	-29.569	102.479	132.048	132	109
HU7 GS195A, Huruiki	300	95	86	489	55	-46.236	6.741	-31.746	-13.908	-19.117	-111.008	6.741	117.750	118	67
HU-5 GS 234-A, Huruiki	296	83	82	560	47	-46.953	-6.7413	-34.920	-1.408	-30.882	-120.906	0	120.906	121	55
GS370 2-7, Huruiki	377	129	134	690	31	-32.437	44.943	6.349	21.478	-54.411	-86.849	72.771	159.620	160	99
Coromandel Volcanic Zone															
GS148-1 Te Ahumata, Gt Barrier	507	62	146	473	75	-9.139	-30.337	15.873	-16.725	10.294	-56.202	26.167	82.369	82	56
GT830-1 Awana 23, Gt Barrier	496	105	126	522	34	-11.111	17.977	0	-8.098	-50	-69.209	17.977	87.187	**87**	**37**
GT850 Site 33 Fanal, Mokohinau Is	522	152	90	690	53	-6.451	70.786	-28.571	21.478	-22.058	-57.081	92.265	149.347	excluded	98
GT844 Purangi 31 run A Coromandel	323	198	102	550	37	-42.114	122.471	-19.047	-3.1698	-45.588	-109.919	122.471	232.391	excluded	167
GT847 Maratoto32 runA, Coromandel	460	98	110	355	78	-17.562	10.112	-12.698	-37.5	14.705	-67.761	24.818	92.579	93	66
Whangamata RO-16 GT476 run a	409	213	120	491	33	-26.702	139.325	-4.761	-13.556	-51.470	-96.491	139.325	235.817	excluded	180
Waihi GT843, Coromandel	368	495	12	531	34	-51.630	456.179	-90.4761	-6.514	-50	-198.620	456.179	654.800	excluded	515
Tairua GS631, Coromandel	328	366	58	770	38	-41.218	311.235	-53.968	35.563	-44.117	-139.304	346.799	486.103	excluded	388
Tairua GS629 run a, Coromandel	342	316	83	841	47	-38.709	255.056	-34.126	48.063	-30.882	-103.719	303.119	406.838	excluded	343
Tairua GS629 run b, Coromandel	332	378	99	799	53	-40.5011	324.719	-21.428	40.669	-22.058	-83.989	365.388	449.377	excluded	406
Hahei HA41-L21a, Coromandel	334	226	141	675	66	-40.143	153.932	11.904	18.838	-2.941	-43.084	184.675	227.759	excluded	215
Taupo Region															
ON-33 run-a Ongaroto GT355	417	281	64	574	44	-25.268	215.730	-49.206	1.0563	-54.545	-129.020	216.786	345.807	excluded	242
MA-37 run-a Maraetai GT282	390	309	70	544	49	-30.107	247.191	-44.444	-4.225	-27.941	-106.718	247.191	353.909	excluded	282
RO-14 run-a Whakarewarewa GT18	400	237	81	726	47	-28.315	166.292	-35.714	27.816	-30.882	-94.912	194.109	289.021	excluded	223
Mayor Island															
MI-1 Mayor Island	349	21	395	4192	308	-37.455	-76.404	213.492	638.028	352.941	-113.859	1204.461	1318.321	excluded	762
UNKNOWN															
Group Unknown 2: 13-1 run1&2	558	89	126	568	68	0	0	0	0	0	0	0	0		0

Excluded* = Using only Rb, Sr, Y, Zr and Nb - a source is excluded when any single trace element value is >60% different from the unknown source.

Excluded = Using only Rb, Sr, and Zr - a source is excluded when any single trace element value is >60% different from the unknown source.**

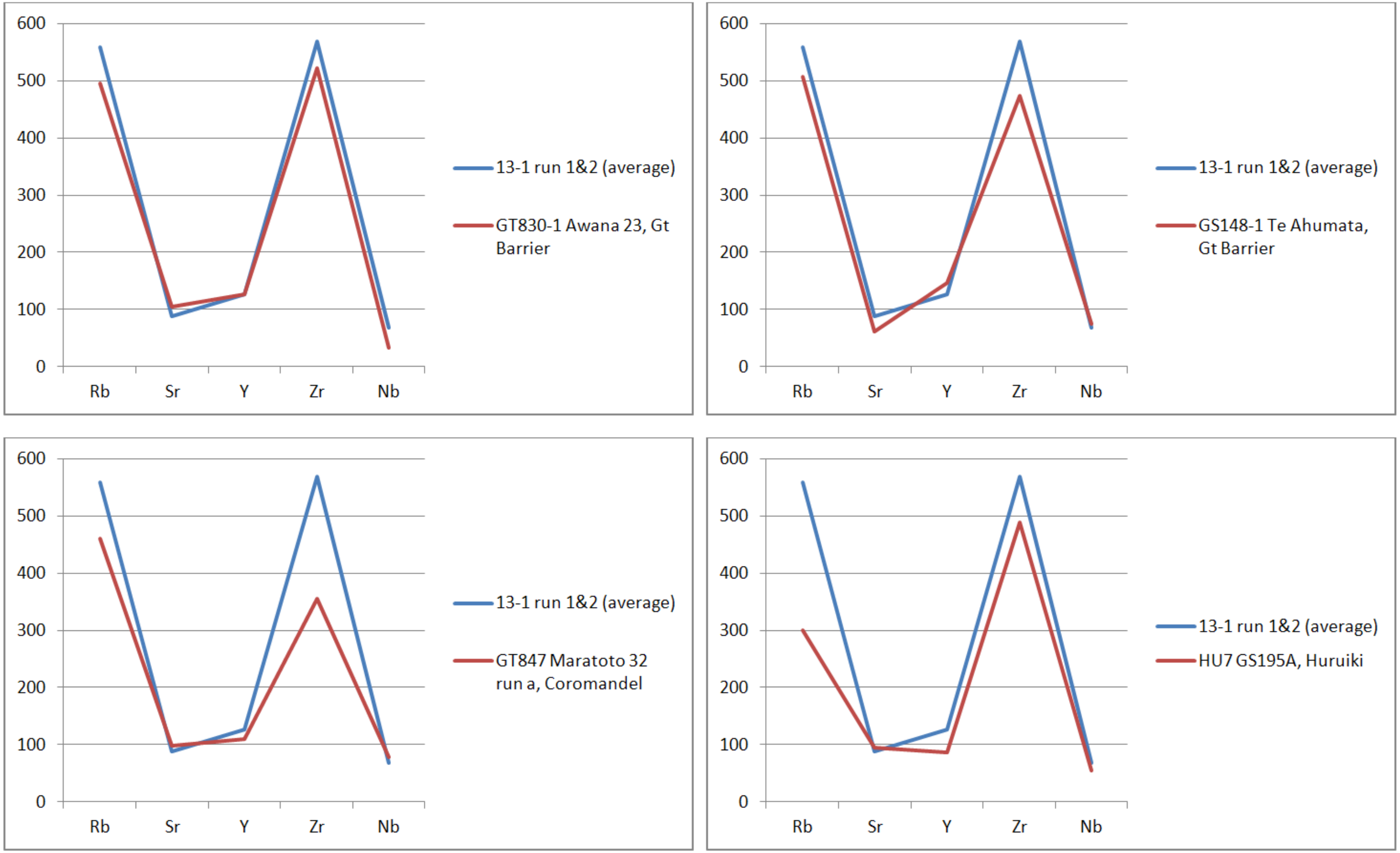


Table F comment: Close match to Awana and to a lesser extent Te Ahumata. No match to Maratoto or Huruiki. Most likely source is Awana.

Appendx 5 i

A description of the types of volcanic rock present on Tawhiti Rahi Island is given here. This is written by the author and is a based on published accounts and from direct analysis of material by Dr Michael Palin of the University of Otago Geology Department, made in 2013.

Tawhiti Rahi Island: Local Volcanic Rock.

As has been described in detail in the geology section of the environmental chapter **(Chapter 4)** the surface of this island is covered with volcanic ash and tephra that was ejected from the ancient rhyolitic volcano that created the island group. First described as rhyolitic breccias (Bartrum, 1936) today the rock is more commonly identified as rhyolitic tuff formed from sub-areal and/or marine deposits laid down during the course of the eruptions. As the island is traversed the rock encountered varies widely in size from 10cm cobbles up to boulders many meters across.

Prof Michael Palin of the UO Geology Department noted that eruptions from rhyolitic volcanoes of the type found at the Poor Knights Islands characteristically produced surface deposits of various sized material ranging from fine ash through larger lapilli to large bombs. This material is comprised of microscopic glass sherds, minerals and other rock collected during the eruption event such as is found in breccias. All the material found on Tawhiti Rahi will have been deposited through ash fall and/or ignimbrite (pyroclastic) flow events. The ash fall of fine material would be thickest near the eruption centre and would be susceptible to subsequent erosion events causing re-deposition across the landscape. The 100-150 degree temperatures involved did not significantly modify this material though it is often found with earth and plant components mixed in. Post deposition processes involving water percolation and compaction lead to localized concretion happening. The ignimbrite flows on the other hand were formed from a collapsing column of volcanic material that travelled at high speed at ground level away from the eruption centre. Both large and small sized material could be widely distributed by such flows and the very hot nature of these events (often at 1000 degrees Celsius) caused significant welding to the parent material that is easily identifiable.

Professor Palin's examination of representative samples of the volcanic rock found in an archaeological context on Tawhiti Rahi Island identified a post depositional process of silicification. His preliminary assessment noted that that the varying degree of 'white' colour in the islands rock is due to the parent rhyolitic rock material being partly or totally replaced by silica in a post depositional process when warm silica rich water permeated the ground mass formed by ash fall or pyroclastic flow. As this water cooled it replaced the parent material with silica which progressively became lighter in colour as the silica content increased. Due to this inflow of silica some of the rock also has quartz, alkali and/or feldspar present that can be seen as veins or inclusions in and around the parent rhyolitic tuff. Where this replacement process has been completed the rock is distinctly white and has in places a 'porcelain' like appearance. In one instance a large area of porcelain' white rock was interspersed with a thin translucent layer of material that gave the appearance of a glass. Initially thought to be rhyolitic obsidian its hardness in resisting numerous rock hammer blows suggests that it is instead a rather extreme form of this silicification process (Fig. 1 below).

Archaeological typology of local rhyolitic rock

Volcanic rock recovered from archaeological sites throughout this island is a subset of the natural distribution of material present on the island but may include some culturally introduced rock from other localities (e.g. all the obsidian and possibly the sinter water rolled cobbles). The several hundred samples recovered vary widely in silica content, grain size and in the presence or absence of coinchoidal fracture characteristics. For the purposes of this research it has been broadly categorized into 6 types.

Fig. 1 Extreme silicification resulting in 'porcelain' like rock and thin sheets of very hard glassy material.

1. *Rhyolitic tuff:* Bag 65/1, OBJ1403, DSC_0031]

This dark grey rock is the dominant material and is found in all parts of the island. It varies from dark grey to medium dark grey in colour. The lighter coloured samples indicate that a small amount of silica replacing the parent rhyolitic rock has occurred following the eruption. Grain size ranges from rough to medium and it is often highly aerated due to rapid cooling during the eruption event and all the samples lack coinchoidal fracture. This rock type is commonly found in field structures such as walls rows and stone facings. Some of the non-aerated rock has been heat cracked in fire places and earth ovens (referred to in the text as 'fire cracked rock').

2. *Silicified rhyolitic tuff:* [Bag 65/4, OBJ1400, DSC_0041]

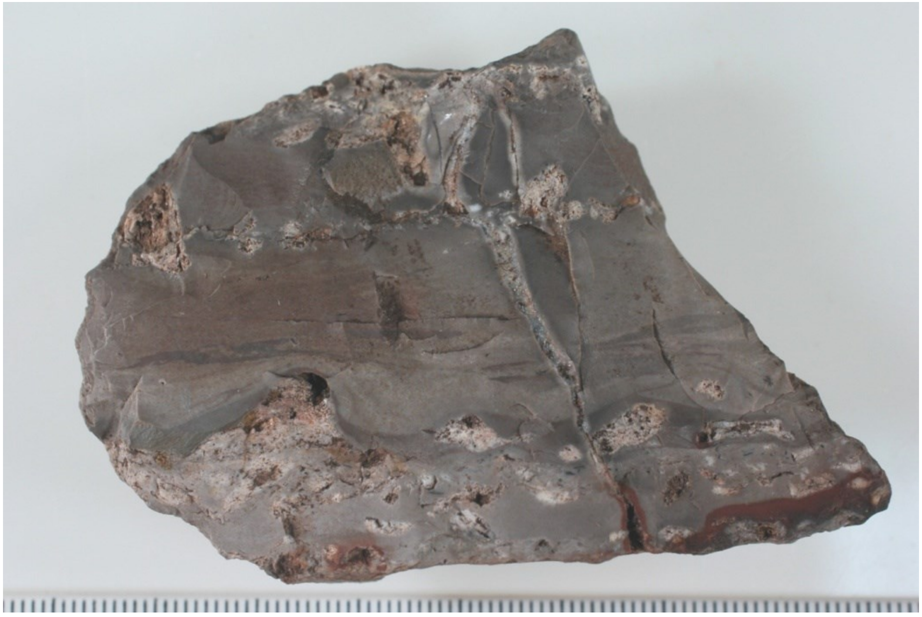
This medium dark grey to medium grey rock is found in many places around the island. All samples have had partial silica replacement of the parent rhyolitic material sometime after deposition. This has resulted in a medium to fine grained material sometimes with minor banding. It has moderate to good coinchoidal fracture that can produce usable cutting edges for cultural use (see experimental report). A number of samples of have been excavated from confirmed cultural contexts however identifiable artefacts are rare.

3. *Silicified sinter:* [Bag 328/8, OBJ1215, DSC_0054]

This medium grey to dull white rock is rare being found solely in archaeological sites and only in the form of hand sized or smaller water rolled cobbles. Extensive silica replacement has occurred when warm silica rich water permeated the ground mass formed by ash fall or pyroclastic flow. As this water cooled it replaced the parent material with silica and progressively became lighter in colour as the silica content increased. The rock often contains phenocrysts of feldspar and the occasional 'sugary' outside layer of hard quartz can reflect a high degree of silicification. These rocks formed their water rolled shape either in streams or on rock platform dimples as can be found on the adjacent island of Aorangi and hand sized specimens are commonly found in association with cultural deposits of obsidian suggesting that they were used as percussion hammer-stones for flaking obsidian. This particular sample is referred to as silicified porphorytic rock. Along with other less silicious rock often without phenocrysts (e.g. 337/9) this group ofwater rolled rock is collectively referred to here as silicified sinter.

4. *Silicious ash:* [Bag 54, OBJ1443, DSC_0025]

This dark grey rock is very fined grained and is almost chert or flint like in appearance. It is completely siIicious and contains bands and isolated inclusions of crystal. It is very rare with only one sample being found within the large obsidian work-floor of site R06-25. It was most likely formed when the original rhyolitic ash fall became completely silicified. Microscopic examination shows the white inclusion material to be precipitated crystals of quartz or feldspar that formed in cavities into which water has flowed after silicification has occurred. The dark grey chert like parts of this sample lacking inclusions would have good coinchoidal fracture characteristics. However although clearly deposited within an archaeological context this particular sample does not appear to have been culturally modified.



5. *Silicious tuff:* [Bag 23, OBJ1444, DSC_0037]

This rock sample is creamy white in colour and in places has a 'porcelain' like in appearance. Characterized by open spaces and layering of material, the parent rhyolitic ash has been completely replaced by silica. These rocks are occasional finds scattered through-out the island. They are occasionally found in stone structures but no artefacts have been found made from this rock. This is most likely due to their lack of coinchoidal fracture that makes them unsuitable for flaking. In addition no samples found within cultural contexts have been fire cracked which suggests that strongly quartz like fracture characteristics made them unsuitable as thermal sinks in Māori hearths or earth ovens.

6. *Breccia:* [Bag 134, OBJ1439, DSC_0035] This rock is light grey in colour and has multiple small to tiny inclusions from many other rocks that vary from

white to black in colour. Being a pyroclastic rock it formed from the material in the eruptive column as well as older material from the magma conduit. This material is heated and molded together to form a rock with numerous small angular fragments known as breccias. Possibly due to weathering breccias of their surfaces they are rarely identified on Tawhiti Rahi Island except in archaeological sites where they have been cleaved and the distinctive composition is recently exposed. As this sample shows Breccia can have limited coinchoidal fracture characteristics and produce sharp edges, however a lack of any artefacts made from this material means it is unclear if it was culturally used.

Comment

Most of the ground surface on Tawhiti Rahi Island was originally covered with a layer of tephra as can be seen by the two remnant areas of clearly unmodified ground [See Feature OBJID 2088 & 2447] In terms of stone structures all variants of the local tuff have been used as a construction material to build the archaeological landscape described in part 1 of chapter 5. Specifically they have been extensively used to face the earth terraces as well as forming the bulk of the garden mounds, rows and alignments. The area where rock has been removed is even more significant in that these are locations where ethnographic sources indicate gardening occurred in prehistory.

Clearly some of the rhyolitic tuff was used for other cultural purposes with examples of fire cracked rock being found in and on many of the habitation terraces (see section 5.3.1.2Non-Obsidian Lithics). Also the silicious sinter hammer-stones found in association with obsidian work floors are rhyolitic in origin however the lack of any water rolled rock in the seasonal island streams suggests that these may have been imports from some other rhyolitic source (see discussion on hammer-stones). However at present the only confirmed artefacts made from local volcanic rock come from silicified rhyolitic tuff and take the form of flaked pieces and occasional cores. The choice of this particular rock type is presumably due to their high silica content that has partially replace the parent rhyolite, producing a homogeneous and fine grained rock that has coinchoidal fracture characteristics and which therefore can be made into flake tools (see Appendix 5 i). Examples of such tools have all been found in archaeological contexts such as at Hearth site R06-24 and at the open site R06-85. The fact that so few locally sourced silicified rhyolitic artefacts were found when compared to the extensive cultural deposits of imported obsidian suggests that human settlement was of short duration. This is discussed further at the end of chapter 5.

James Robinson2013

Bartrum JA 1936 Notes on the geology of Three Kings and other outlying islands of Northern New Zealand. *New Zealand Journal of Science and Technology.* 17:520-530

Appendix 5 ii

In 2006 Dr Marianne Turner accompanied one of the field trips to Tawhiti Rahi Island. During her time there she carried out lithic research resulting in two small reports.

1. The first of these some experimental work to determine whether the local volcanic rock was suitable for traditional knapping practices.

2. The second are field notes on the source of 'Silicified Tuff'. This consisted of a field inspection that observed form and availability. Samples were taken in order to test for flaws and flake ability and for future experimental tests

Report 1. Experiment to test quality of Poor Knights 'Silicified Tuff'

April 25th 2006

Three Experiments were undertaken in order to test the comparative quality of the stone and what it may have been best used for.

The Stone Types

Two flakes were used from Tawhiti Rahi Island on Poor Knights from near the possible quarry site. One flake (Flake 4) looks quite chalky and was predicted to be the poorest quality stone of the flakable material found there. Flake 1 looked more quartz-like without the chalky look.

The two test flakes were one of Mayor Island obsidian and one of Kuotunu sinter from Coromandel Peninsula. Use of both is well attested in the archaeological record.

Qualities tested for

Three qualities were desirable for use in prehistoric Māori culture: flakeability, hardness and toughness. A rock possessing all three of these features was probably among the most valued stone of all. An example with all three at high levels would be Nelson/Marlborough argillite.

Flakeability: The material from Poor Knights was proved in the field to be flakable though flaws limited the size of flakes that could be made. Still for most purposes to which flake tools were put, the size of the flakes was more than adequate.

Hardness: Hardness is a quality that imparts a very good cutting ability. This is the primary value of obsidian – it is the cutting stone supreme – a fresh flake being akin to a surgeon's scapel in sharpness. Particularly in the preparation of soft materials, a sharp cutting stone is very important. One of the major essential uses of obsidian would have been in the preparation of flax fibre for weaving etc (see my AINZ paper 2005 for more details on this). Food preparation and butchering would also have required sharp cutting blades akin to knives and again obsidian is most effective. A good sharp cutting edge is also favoured in scraping tools, for example in removing bark from round branches for handles etc.

Toughness: This is the strength of the stone to withstand violent and/or sustained impact against another strong material. Obsidian, like glass, falls down in this respect (though recent experiments by me have shown that is perhaps somewhat stronger than previously thought – see AINZ paper). Adzes are an example of a tool that requires very tough stone for their manufacture as they are used in precisely the manner described above. Any action that requires use against a strong material like bone or other stone (an anvil for example) will favour rocks that are tough enough to use without sustaining too much edge damage too soon as to render the flake ineffective at the task.

The Tests

Three short tests were carried out with each of the four flakes. The tests were chosen not only to test for hardness and toughness but also because they reflect some common uses for flake tools in prehistoric Māori society.

Test 1- testing for toughness – Bone Sawing

Each flake was used for two minutes continuously to saw a scarf line on a mammal jaw bone. Two observations were made at the end of the experiment:

- The depth and length of the cut made as a test of effectiveness
- The extent and nature of damage to the working edge of the flake

Observations made during the experiment included the amount of force required to make the flake work properly and the point at which it lost its effectiveness and would to be discarded or retouched

Test 2 – testing mainly for hardness – Wood Scraping

Each flake was used for one minute to remove bark from some round branches. Two observations were made during and at the end of the experiment:

- the amount of wood removed
- the smoothness of the wood after bark removed
- the point at which the flake lost its effectiveness

Test 3 – testing for hardness – Flax Cutting

This is the supreme test of sharpness. Cutting across the outer surface of the flax leaf in order to remove the silky fibre (or muka) within requires precision and a very sharp edge or point. If the cut is too deep, the fibre beneath will be damaged. If the flake is not sharp enough the outer fibre will be crushed and bruised rather than cut.

The only observation to be made here is weather the flake was sharp enough to do the job or not.

A word on Experimental Variables

One drawback with this type of experiment is the inability to produce flakes that are exactly the same size with similar edge angles etc. Inevitably some differences in results will reflect differences in flake size, morphology and edge angle. The experimental flakes were roughly the same size (5cm maximum dimension) but Flake 1 and the Mayor Island flake were heavier and more robust with steeper edge angles. Flake 4 in particular had very low edge angles. These differences were taken into consideration when reviewing the results below.

Results of the tests

Test 1: TheKuotunu sinter flake cut the deepest and longest scarf, the Mayor Island flake cut the shallowest scarf. The Poor Knights Flake 1 cut the second longest and deepest scarf. Both this flake and the Mayor Island flake cut the widest scarf probably as a consequence of having higher edge angles.

Both the Mayor Island and the Kuotunu sinter flake suffered the most edge damage and were ineffective and blunt after two minutes. The Poor Knights No 1 flake suffered the least damage and was still working effectively after two minutes. Surprisingly, despite a thin fine edge, the Poor Knights No 4 edge suffered only minor damage and was also still effective after 2 minutes.

Test 2: The obsidian flake performed the best at this task removing the bark effectively and leaving a smooth surface. It was still effective after a minute of use and removed more bark than the other flakes.
The Kuotunu sinter flake was also still effective after a minute but did not remove as much bark as the obsidian flake and left a rougher surface. The two Poor Knights flakes performed poorly leaving a very rough surface.

Test 1: Only the obsidian flake performed this task effectively, the others, particularly the Poor Knights flakes. Only the obsidian flake cut cleanly; the others made ragged tears and bruised the leaf without cutting cleanly through the outer leaf.

Conclusion
The Poor Knights flakes performed best when the quality of toughness was required but performed poorly in those tests where hardness in the form of a sharp cutting edge is desirable.

Surprisingly the flake (No 4) that gave the appearance of not being of good quality proved to have a very durable edge even though it was fine and thin. It is likely that the more robust edge and greater weight gave the No 4 flake an advantage in the toughness test (bone sawing), and does not necessarily indicate that it was superior in quality. In this test it compared well with the Kuotunu sinter flake. It is likely, therefore, that the Māori inhabitants of the Poor Knights would have made use of the material when tasks requiring a tough material were required.

Its relatively poor performance in tasks favoring hardness may go some way to explaining the abundant amounts of worked obsidian found on the islands. From evidence examined elsewhere (see Turner 2005 – AINZ paper) it is clear that when people had a local readily available material they were likely to use it for a greater range of uses than if a material had to be imported. Even if it wasn't the most efficient at the task, its availability and plentiful supply meant that it didn't matter if they had to use twice the number of flakes. With regard to the Poor Knights, the local material could have been used for scraping wood – it just would have taken longer and used up more material compared with using obsidian. It is highly unlikely that it could have used in flax work, however. Obsidian would have been essential for this task.
In the final analysis it would appear, from these experimental results that the local tuff and the imported obsidian had complementary roles, and together could have covered a wide range of tasks involved in food preparation, and wood, bone and fibre working.

Report 2. Field Notes on Source of 'Silicified Tuff'

Field inspection consisted of observations of form and availability. Samples were taken in order to test for flaws and flake ability and for future experimental tests.

Main questions were:
1. Any evidence for use by Māori in prehistory?
2. Is the quality of a nature that it was likely to be used?
3. If so what would they use it for?

For question No 1 – there is a need to confirm that the chert, or at least some of the chert, found in archaeological contexts on the island is the local material (get a geologist to examine archeological and field samples).

The material appears to be quite wide-spread. Observable in most of the areas we passed thru from Camp Bay to the density of rock called 'The Quarry' and as far as I went - N.117 (the eastern path). As is typical of any rock source there is a wide range in terms of quality but the type of material I took as samples and have since tested in experiments (see above) is easy to find and plentiful. It makes up some of the rock in the stone garden features (which has opportunistic advantages!) and one of the worked samples found near the wall of the last site we investigated (April 06) is probably the local stone.

It is generally very fractured and flawed however. This is not necessarily a disadvantage for use as I found sufficiently pure pieces to remove flakes of adequate size for the range of tasks it was likely to be used for. But this observation may be important for understanding quarrying practices or, in this case, procurement practices.

Evidence of actual prehistoric working of the stone was inconclusive though the odd conchoidal flake scar was seen. Had I not been mindful not to contaminate the archaeological environment, the best approach for finding decent material would be to simply crack open a block by smashing it against another. By this means the block usually shatters along the weakest points – along flawed fracture lines – and then it is simply a matter of picking out the relatively pure pieces which would then be removed back to the place of work. Certainly at the 'quarry' there is a lot of broken up material though the degree of weathering is difficult to discern due to the presence of mosses and the like. The quality of the stone at the 'quarry' was no different to that seen elsewhere. The difference here is the sheer abundance of the material. Smashing up smaller blocks and boulders would probably be the preferred strategy in being less energy intensive and simply easier to do for what they needed. The 'quarry' then, is more a particularly dense concentration of stone that was, nevertheless, very likely exploited. A similar situation can be seen on Mayor Island. No 'quarry' as such can be identified simply because the material was so widespread and so readily available in convenient forms. Blocks eroding from seams could easily gathered from the beaches and ridges, or otherwise a sharp tap on a larger boulder or bench was sufficient to furnish numerous cores (personal observation).

The form of the stone is favourable in being blocky and angular. This made it more likely to break into angular pieces that provided better striking platforms for flake removal. A variety of sizes is available particularly and advantageously small blocks that minimized effort in terms of testing. Another advantage was a very fine cortical rind, in some cases with a shiny appearance, and of various colours often moss stained. The material was relatively easy to flake though suitable hammerstones may have had to be imported (any water-rolled pebble beaches?).

While cream and white appear to be the most common varieties in terms of colour, various shades of tan, grey, brown, pink and orange were seen. Several samples are striated and multi-coloured (one sample in shades of pink, grey and cream with dark flecks). Common was a cream to grey brown material that had deceptively matt chalky appearance but as shown above, performed well in the toughness test. Other material is more crystalline with some having quite large crystal inclusions. (A geologist will give you a better description!). This pattern was the same in most areas observed, that is, certain colours of stone could not be attributed to particular areas.

Summary/Implications

These tests and observations have established that the local 'silicified tuff' was readily and, at least on Tawhiti Rahi, widely available in convenient sized angular blocks that could be smashed against others in order to expose pure chunks within. The quality is certainly of a standard comparable to similar silicious materials or chert used in prehistory elsewhere in New Zealand. A good conchoidal fracture was easily achieved. Even when very fine the edges of these flakes could withstand considerable use.

Identification of the material among artifact samples from the island will provide further insights. A number of chert flakes were among those in the collections we made but they were vastly outnumbered by obsidian flakes. The higher visibility of obsidian may partially explain this observation but it was probably a reality that obsidian was more commonly used.

Implications can be drawn from this observation too. Experimental tests showed that the local tuff and imported obsidian had different but complimentary qualities; obsidian for cutting soft materials like flax and wood scraping and the local material for tasks requiring a stronger stone. The use wear patterns on archaeological specimens of both will provide more specific information in this regard.

The study of use wear patterns on the archaeological samples will also provide insights into the types of activities being undertaken on the island, and possibly on the degree to which settlement was permanent or seasonal. If activities were limited mainly to gardening and mutton-birding then the presence of large quantities of obsidian flakes can be seen as consistent with these activities – both probably required baskets (of flax fibre commonly) in which to transport both birds and kumara etc. Obsidian was probably more valuable in food preparation also (gutting fish for example).

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May 15th 2006

Appendix 6

Information about 20th century fires that were notes by various authors when visiting Tawhiti Rahi Island.

Documented Fire events on Tawhiti Rahi

R.B.Sibson Letter to Commissioner of Crown Lands, Auckland 23 Dec 1958

"We camped on the northern island, near a stream which was obviously used by the Māori a long time go. The southern part of this island was swept by fire 20-30 years ago, but the burnt slopes are now deep in toitoi, flax and pohutukawas up to 8ft. which as they grow may kill a flourishing patch of the rare lily Xeronema"

AlsoF. Kinsky & R.B. Sibson Notes on the birds of the Poor Knights Islands.
Notornis 1959, vol 8, issue 5, p132-8

Fire date range 1928-1938

Barbara S. Paris The Establishment of Permanent Vegetation Quadrats on the Poor Knights Islands. Tane (1970) 16:45-51

p.45 "The southern part of the island contains plant communities of two distinct ages. The youngest is a 'meadow' of *Leptocarpus simplex,* toetoe *(Arundo conspicua)*, flax *(Phormium tēnāx*) and several species of grass, with scattered small trees and shrubs of several species between one and six feet high. This probably dates from a fire about twelve years ago (W.Doak, pers. Comm.) The older community has probably developed since a fire in about 1923 (Kinsky & Sibson, 1959)."

1st Fire date circa 1923

2nd Fire date circa 1957

W.R.B. Oliver Vegetation of the Poor Knights Islands
The New Zealand Journal of Science and Technology, May 1925 Vol.7

p.378 "…Fires have destroyed a portion of the scrub in both of the main islets, and in its place has grown up a covering of flax, *Leptocarpus*, and other native plants, with a sprinkling of introduced species. Probably in time scrub will again take possession of these areas.

Fire date sometime before 1924

L. Cockayne Notes on a Brief Botanical Visit to the Poor Knights Islands
Transactions and Proceedings of the New Zealand Institute. 38 (1905): 351-360

On this visit Cockayne did not visit Tawhiti Rahi however Captain Bollons did. He reported back that he….

p.355 "climbed up to the open ground above the cliffs of the northern island……The ground is in many places carpeted with *Mesembrianthemum australe*. Everywhere is *Phormium tēnāx*, sometimes in large masses, at other times dotted about. Large tussocks of *Arundo conspicua* here and there all over the meadow give a distinct character to its physiognomy. Rounded bushes, too, of stunted *Metrosideros tomentosa* are frequent. The meadow is broken into in many places by greater and smaller pieces of scrub, thanks to the shelter afforded by the *Phormium*.

No fire damage visible 1905

This 1905 account suggests that no fire damage was obviously present. It also however suggests that the either the open meadow had survived for 80 years after the island was abandoned by Māori or that other unrecorded fires must have occurred between 1823 and 1905. If this did so it does not appear to be reflected in the charcoal sequence.

Comment:

Looking at these various accounts I believe there is some evidence to suggest that only two fires occurred on Tawhiti Rahi in the early 20th century. One in 1923 and the other in 1957. The gap between them of 34 years may be too small to be visible in the charcoal record.

Appendix 7i

A selection of previously unexamined faunal bone material was analysed from four isolate sites (R06-11. 14. 17 & 20), and at three surface concentrations of midden found at the specialist Carver site R06-27, at dispersed hamlet Hearth site R06-24 and at open site R06-85 (Table 5.40). Non-fishbone bone made up a small percentage of the assemblage and was analysed by Sheryl McPherson (Appendix 7ii). However fishbone dominated the collection and was analysed by Yolanda Vogel. Her report is presented here (Appendix 7i).

Fishing on Tawhiti Rahi, Poor Knights Islands

This report discusses the analysis and results of a fishbone assemblage from Tawhiti Rahi, Poor Knights Islands. It will outline the methods used in identification of the material, results of the analysis, and a discussion of those results. The material resulted from surface collections in an area of approximately 9 m by 4 m, with no indications of further deposits subsurface. This was the only such surface midden deposit observed on the island, and included fish, bird, tuatara and mammal (pig and dog) bone, as well as charcoal and obsidian flakes. The bird, tuatara and mammal bone is yet to be identified to element and, in the case of bird, species. This will be done at a later date and a subsequent report will be produced. The presence of pig bone places the midden in the post-contact period.

The methodology used in this analysis differed somewhat from that which is normally used for New Zealand fishbone assemblages. Most assemblages are identified using five paired mouth bones (dentary, premaxilla, maxilla, articular and quadrate), with all other material remaining unidentified (Leach, 1997; 2006). However, recent work in the Otago Archaeological Laboratory and elsewhere has shown that the use of a wider range of elements can have significant affects on measures of relative abundance, and thus interpretations of past fishing practices (Vogel,2005; Walter, 1998; Weisler, 1993). The use of more elements also allows for interpretations that go beyond relative abundance, and provides a fuller account of the material present. Unfortunately, the O.A.L. New Zealand fishbone reference collection is currently set up for routine identification of the five paired mouth bones and certain "special" bones only. In the current investigation, material was identified to element as far as possible, with the five paired mouth bones identified to species level, though in some cases only family or genera could be established with certainty, with some bones unable to be identified beyond element, due to constraints within the reference collection. Those elements for which no match could be found in the collection were designated Not In Collection (NIC) to distinguish them from bones unidentifiable due to taphonomic reasons, such as breakage, resulting in the loss of characteristic landmark features. The fishbone was, for the most part, in a good state of preservation, aiding in identification.

The material from each separate provenance unit was given an OAL number that encoded that information. Following identification, the bones were bagged and labelled with a unique number, made up of the OAL number for the provenance from which the bone came, the code BF (bone – fish) to identify it as fish bone, and a second number to denote samples within each provenance. Each bag was also labelled with full taxonomic, element, and quantification (NISP) information. This information was entered into an excel spreadsheet (Appendix A), along with MNE calculations. From this pivot tables for MNE (Table 1) and NISP (Table 2) were created, and MNIs calculated based on this data.

The assemblage yielded a total of 1501 pieces of bone. Of these, 103 pieces (6.8%) were able to be identified to taxonomic level, with a further 1032 (68.8%) identified to element. Six elements appearing to belong to the same species were not able to be assigned to taxa as no match was found in the reference collection. Of the remaining unintified elements a further 107 (7%) are potentially identifiable to taxa. Unidentifiable fragments account for 24.4% of the assemblage.

Table 1 MNE for identified fishbone elements

Sum of MNE		SIDE			
SPECIES	ELEMENT	left	n/a	right	Grand Total
Arripis trutta	quadrate			1	1
Arripis trutta Total				1	1
cf carangidae	articular			1	1
	dentary	1			1
cf carangidae Total		1		1	2
cf trachurus novaezelandiae	maxilla	1			1
cf trachurus novaezelandiae Total		1			1
Elasmobranchii	vertebra		3		3
Elasmobranchii Total			3		3
Muraenidae	articular	1		2	3
	dentary			1	1
	premaxilla			1	1
	quadrate			2	2
Muraenidae Total		1		6	7
Nemadactylus macrpterus	dentary			1	1
Nemadactylus macrpterus Total				1	1
NIC	dentary	1			1
	maxilla			1	1
	premaxilla	3			3
	quadrate			1	1
NIC Total		4		2	6
Notolabrus sp.	dentary	1		1	2
	lower pharyngeal		6		6
	premaxilla			3	3
	tooth		1		1
	upper pharyngeal	2			2
Notolabrus sp. Total		3	7	4	14
Pagrus auratus	articular	2		2	4
	dentary	1		2	3
	maxilla	2		2	4
	otolith			1	1
	premaxilla	9		6	15
	quadrate	2			2
Pagrus auratus Total		16		13	29
Parika scaber	basihyal		1		1
	dorsal spine		5		5
	premaxilla			1	1
Parika scaber Total			6	1	7
Polyprion oxygeneios	premaxilla	1			1

Polyprion oxygeneios Total		1			1
Psuedophycis bachus	premaxilla	2			2
Psuedophycis bachus Total		2			2
Serranidae	articular	1		1	2
	dentary	2		5	7
	maxilla			6	6
	premaxilla	3		1	4
	quadrate	2		1	3
Serranidae Total		8		14	22
Thyrsites atun	articular	2			2
	dentary	2		4	6
	maxilla	1			1
	premaxilla			1	1
	quadrate	1			1
Thyrsites atun Total		6		5	11
Unidentified	articular	1			1
	basihyal		1		1
	basioccipital		1		1
	basiterygium	1	1	2	4
	ceratohyal	5		4	9
	cleithrum	3		4	7
	coracoid	3		5	8
	dorsal spine		67		67
	dorsal/pterygiophore		11		11
	ectopterygoid	3		1	4
	epihyal	3		3	6
	Fragments*		N/A		N/A
	hyomandibular	5		16	21
	identifiable		1		1
	interopercular	1			1
	maxilla			1	1
	mesopterygoid			1	1
	misc spines and rays		0		0
	opercular	7		4	11
	palatine			2	2
	parasphenoid		6		6
	pharyngeal plate		3		3
	post temporal	3		1	4
	preopercular	6	2	7	15
	pterygiophore		67		67
	radial		3		3
	scale		4		4

	scapula	6		10	16
	subopercular			2	2
	supracleithrum	3		2	5
	ultimate vertebra		10		10
	upper pharyngeal	2		1	3
	vertebra		2		2
	vomer		3		3
Unidentified Total		52	182	66	300
Grand Total		95	198	114	407

* It is not possible to assign MNE to unidentified fragments

Table 2 NISP values for identified fishbone elements

Sum of NISP		**SIDE**			
SPECIES	ELEMENT	left	n/a	right	Grand Total
Arripis trutta	quadrate			1	1
Arripis trutta Total				1	1
cf carangidae	articular			1	1
	dentary	1			1
cf carangidae Total		1		1	2
cf trachurus novaezelandiae	maxilla	1			1
cf trachurus novaezelandiae Total		1			1
Elasmobranchii	vertebra		5		5
Elasmobranchii Total			5		5
Muraenidae	articular	1		2	3
	dentary			1	1
	premaxilla			1	1
	quadrate			2	2
Muraenidae Total		1		6	7
Nemadactylus macrpterus	dentary			1	1
Nemadactylus macrpterus Total				1	1
NIC	dentary	1			1
	maxilla			1	1
	premaxilla	3			3
	quadrate			1	1
NIC Total		4		2	6
Notolabrus sp.	dentary	1		1	2
	lower pharyngeal		6		6
	premaxilla			3	3
	tooth		1		1
	upper pharyngeal	2			2

Notolabrus sp. Total		3	7	4	14
Pagrus auratus	articular	2		2	4
	dentary	1		2	3
	maxilla	2		2	4
	otolith			1	1
	premaxilla	9		6	15
	quadrate	2			2
Pagrus auratus Total		16		13	29
Parika scaber	basihyal		1		1
	dorsal spine		5		5
	premaxilla			1	1
Parika scaber Total			6	1	7
Polyprion oxygeneios	premaxilla	1			1
Polyprion oxygeneios Total		1			1
Psuedophycis bachus	premaxilla	2			2
Psuedophycis bachus Total		2			2
Serranidae	articular	1		1	2
	dentary	2		5	7
	maxilla			6	6
	premaxilla	3		1	4
	quadrate	2		1	3
Serranidae Total		8		14	22
Thyrsites atun	articular	2			2
	dentary	2		4	6
	maxilla	1			1
	premaxilla			1	1
	quadrate	1			1
Thyrsites atun Total		6		5	11
Unidentified	articular	1			1
	basihyal		1		1
	basioccipital		1		1
	basiterygium	1	1	2	4
	ceratohyal	5		4	9
	cleithrum	3		4	7
	coracoid	3		5	8
	dorsal spine		114		114
	dorsal/pterygiophore		11		11
	ectopterygoid	3		1	4
	epihyal	3		3	6
	fragments		366		366
	hyomandibular	5		16	21
	identifiable		1		1

Unidentified (continued)	interopercular	1			1
	maxilla			1	1
	mesopterygoid			1	1
	misc spines and rays		207		207
	opercular	7		4	11
	palatine			2	2
	parasphenoid		6		6
	pharyngeal plate		3		3
	post temporal	3		1	4
	preopercular	6	2	7	15
	pterygiophore		67		67
	radial		3		3
	scale		4		4
	scapula	6		10	16
	subopercular			2	2
	supracleithrum	3		2	5
	ultimate vertebra		16		16
	upper pharyngeal	2		1	3
	vertebra		468		468
	vomer		3		3
Unidentified Total		52	1274	66	1392
Grand Total		95	1292	114	1501

Fourteen taxa are represented in the assemblage, including that currently unable to be assigned to taxa, with eight identified to species level, one to genus, three to family and one to sub-class. Eight of these, *Pagrus auratus* (Snapper), *Notolabrus sp.* (probably Spotty), Serranidae (groupers, rock cod, etc), *Thyrsites atun* (Barracouta), *Parika scaber* (Leatherjacket), Muraenidae (Moray eels), the unidentified species, and *Psuedophycis bachus* (Red cod) yielded 4% or more of the assemblage each based on MNI, with the first five all yielding more than 10% each of the assemblage (Figure 1). The remaining families/species all yielded an MNI of 1, representing less than 2% of the assemblage each.

The Poor Knights Islands lie off the coast of the north east North Island, and as such are subject to the East Auckland Current (Stanton et al, 1997; cited in Denny et al, 2003), resulting in a higher species diversity than the remainder of the country and the appearance of some tropical species and sub-tropical taxa, for example Muraenidae (Francis, 1996). The island itself is characterised by steep cliffs with few suitable landing places and no beaches. As such the surrounding marine environment consists of rocky reefs surrounding the island, deepening into the continental shelf. This has obvious implications for fishing practices, given that fishing from the island itself would have been extremely difficult.

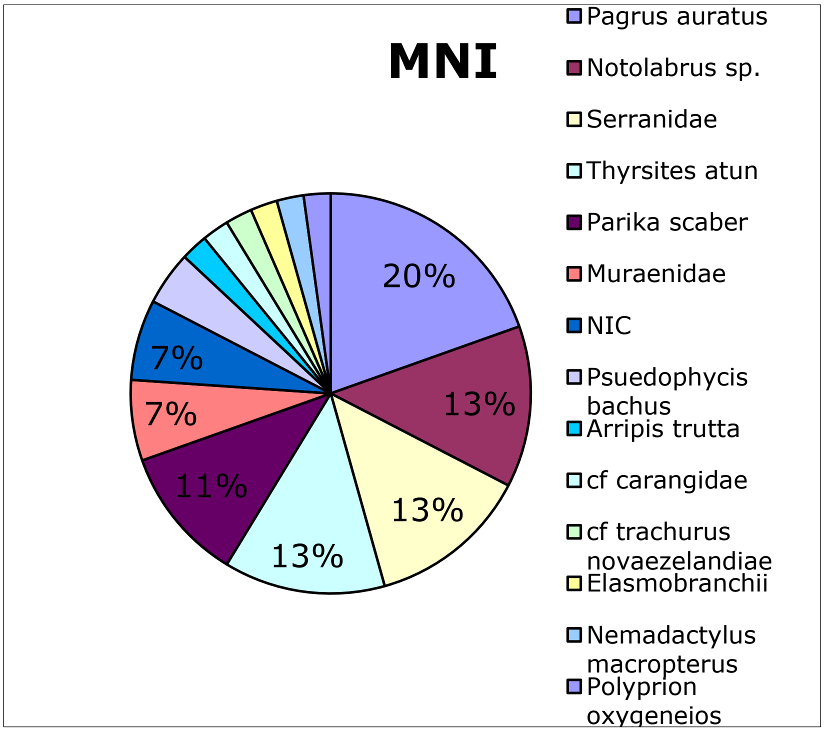

Figure 1 MNI values for fishbone from Tawhiti Rahi

All the taxa represented in the Poor Knights assemblage are known to occur around the island in modern times (Denny et al, 2003), and while it cannot be confirmed that this was the case in earlier times, it is likely that all of the fish represented could have been caught relatively close to the island. The majority of these fish can be caught using a baited hook or net, the exceptions being barracouta and kahawai, which are more likely to have be caught by trolling (Anderson, 1997).

It is usual in this temperate region to see a focus on one or two species with others making up only a small part of the assemblage (Leach, 2006). As can be clearly seen in Figure 1, this is not the case here, with five species contributing more than 10% of the assemblage each, and making up 70% of the assemblage between them, and the highest ranking taxa, snapper, accounting for only 20% of the assemblage. This is more similar to a tropical Pacific fishing strategy in that it represents a more generalised strategy focusing on a number of families/species, rather than just one or two. While it would be easy to say that this is due in some way to the effect of the East Auckland Current, this does not explain why a similar pattern is not also seen at other north east North Island archaeological sites. Similarly, the EAC alone does not explain the number of moray eels present in the assemblage. As far as the author is aware, this taxon has not been identified in any other New Zealand assemblage to date. This is also the case for Serranidae. Leach (2006: 23) lists those taxa known to have been identified in archaeological assemblages, with both of these taxa absent. In fact, Serranidae are not even present in the OAL reference collection for New Zealand, and were identified in the Poor Knights assemblage using the OAL Pacific reference collection. The presence of Muraenidae and Serranidae in the waters around the Poor Knights is undeniably a product of the EAC, but their presence in the fishbone assemblage requires further explanation.

The Poor Knights fishbone assemblage is relatively small with an MNI of just 46, and given the surface nature of the deposits, an argument could be made that the results are skewed due to taphonomic factors. However, the number of unidentifiable fragments is in line with what has been observed in Pacific assemblages where all material has been identified as far as possible (Vogel, 2005; Walter, 1998; Walter & Anderson, 2002), and several fragile elements not identified to taxa are well represented. It should also be noted that taxa with large robust elements, such as snapper, would be less affected by these taphonomic factors. As such, the assemblage is likely a fair representation of the taxa being exploited and their relative abundances in the catch (particularly for the top five taxa), at least as far as any archaeological assemblage can be.

A potential hypothesis relating to this assemblage is that it is the result of activities by people from the mainland travelling to the island to tend gardens, and thus representing a relatively short-term event (Robinson, 2007 pers. comm.). If this is the case, it may well explain the generalised nature of fishing activities, with people catching what was readily available, either from the rocks or, more likely given the terrain, from stationary canoes, without targeting particular species. The barracouta and kahawai may also have caught close to the island, or may have been the result of trolling during the voyage from the mainland.

The fishbone from the Poor Knights Island is an interesting assemblage. It clearly shows that, while regional characteristics in fishing practices can be observed, and are important to our overall understanding of fishing, there are always exceptions to the norm. People will adapt their fishing strategies to suit not only the environment and the available species, but also their needs.

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Appendix 7ii

A selection of previously unexamined faunal bone material was analysed from four isolate sites (R06-11. 14. 17 & 20), and at three surface concentrations of midden found at the specialist Carver site R06-27, at dispersed hamlet Hearth site R06-24 and at open site R06-85 (Table 5.40). Fishbone dominated the collection and was analysed by Yolanda Vogel (Appendix 7i). The remnant non-fishbone bone was analysed by Sheryl McPherson and is presented here as a spread sheet.

Bag	Class	Taxa	Element	Side	NISP	Notes
1	Reptile	Sphenodon	Humerus	L	1	
2	Reptile	Sphenodon	Femur	L	1	
3	Bird	Puffinus bulleri	Humerus	R	1	
4	Bird	Unidentified	Tarsometatarsus	L	1	Myna?Magpie?
5	Mammal	Canis familiaris	Atlas	N/A	1	
6	Bird	Puffinus griseus	Ulna	L	1	
7	Bird	Unidentified	Long bone	N/A	2	
8	Unidentified	Unidentified	Fragment	N/A	1	
9	Reptile	Sphenodon	Cervical vertebra	N/A	1	
10	Reptile	Sphenodon	Axis/atlas	N/A	1	
11	Reptile	Sphenodon	Maxilla	L	1	
12	Mammal	Canis familiaris	Tooth	N/A	1	
13	Reptile	Sphenodon	Mandible	L	1	
14	Reptile	Sphenodon	Maxilla	L	2	
15	Bird	Unidentified	Cervical vertebra	N/A	1	
16	Unidentified	Unidentified	Fragment	N/A	1	
17	Mammal	Sus scrofa	Mandible	L	1	
18	Bird	Unidentified	Mandible	N/A	1	
19	Bird	Unidentified	Corocoid	L	1	
20	Bird	Unidentified	Ulna	L	1	
21	Bird	Unidentified	Sternum	N/A	1	
22	Bird	Unidentified	Pelvis	N/A	2	MNE=1
23	Bird	Unidentified	Rib	N/A	4	
24	Unidentified	Unidentified	Long bone	N/A	3	Bird?
25	Bird	Unidentified	Femur	N/A	1	
26	Bird	Unidentified	Tibiotarsus	R	1	

Bag	Class	Taxa	Element	Side	NISP	Notes
27	Bird	Unidentified	Long bone	N/A	1	Very degraded and broken
28	Unidentified	Unidentified	Fragment	N/A	1	
29	Bird	Puffinus sp.	Corocoid	L	1	
30	Unidentified	Unidentified	Unidentified	N/A	3	Tuatara skull?
31	Reptile	Sphenodon	Cranium	N/A	1	
32	Unidentified	Unidentified	Unidentified	N/A	1	Pelvis?
33	Reptile	Sphenodon	Quadrate	R	1	
34	Reptile	Sphenodon	Unidentified	N/A	1	Skull?
35	Unidentified	Unidentified	Vertebra	N/A	1	Atlas?
36	Unidentified	Unidentified	Fragment	N/A	4	
37	Bird	Unidentified	Carpometatarsus	R	1	
38	Unidentified	Unidentified	Unidentified	N/A	1	Quadrate of reptile?
39	Reptile	Unidentified	Maxilla	L	1	Lizard?
40	Reptile	Unidentified	Humerus	R	1	Lizard?
42	Unidentified	Unidentified	Rib	N/A	1	Mammal?
43	Mammal	Unidentified	Temporal	R	1	Dog?
44	Bird	Unidentified	Sternum	N/A	1	
45	Bird	Unidentified	Humerus	R	1	
46	Bird	Unidentified	Tibiotarsus	R	1	
47	Mammal	Unidentified	Fragment	N/A	1	
48	Unidentified	Unidentified	Vertebra	N/A	1	
49	Unidentified	Unidentified	Long bone	N/A	1	Bird?
50	Bird	Puffinus sp.	Femur	L	1	
51	Bird	Unidentified	Tarsometatarsus?	L	1	
52	Bird	Unidentified	Humerus	R	1	
53	Bird	Unidentified	Femur	R	1	

Bag	Class		Taxa	Element	Side	NISP
54	Non bone material					
55	Bird	Unidentified	Sternum	N/A	1	
56	Bird	Puffinus sp.	Tarsometatarsus	L	1	
57	Unidentified	Unidentified	Vertebra	N/A	1	
58	Unidentified	Unidentified	Vertebra	N/A	1	
59	Mammal	Otariidae sp.	Vertebra	N/A	1	Unfused epiphysis
62	Reptile	Sphenodon	Mandible	L	1	
64	Bird	Puffinus sp.	Tibiotarsus	R	1	
65	Bird	Unidentified	Mandible	N/A	1	

Appendix 8i

In 2009 Statistician Dr Peter Dillingham from the University of Otago Department of Mathematics and Statistics, made a Bayesian analysis of the pollen core using age constraints identified in the historical literature and calibrated radiocarbon dates. These are his results.

Initial analysis of pollen core from Tawhiti Rahi

1. Radiocarbon dates (unmodelled)

The calibrated radiocarbon dates are presented in Table 1. No stratigraphic or other information is used in this calibration.

Table 1. Calibrated radiocarbon dates (provided by Dr J. Wilmshurst in 2009).

Depth (cm)	14C code	14C age	14C error	Material dated	13C	Age (AD; 95% Range)	Noteable events
40	Wk-23857	505	30	Soily peat	-25.2	1400 - 1460	
52	Wk-26884	601	30	Soily peat	-24.8	1310 - 1440	
53	Wk-23858	665	30	Soily peat	-25.2	1290 - 1400	
58	Wk-26885	512	30	Soily peat	-25.1	1410 - 1460*	Kaharoa Tephra begins (56 cm; 1314)
66	Wk-26754	1079	50	Soily peat	n.d	890 - 1150*	Early Maori (66 cm; after 1280 AD)
67	Wk-26755	702	50	Soily peat	n.d	1270 - 1400	
69	Wk-23859	974	30	Soily peat	-25.3	1030 - 1180	
70	Wk-26019	1116	30	bulk peat	-26.1	900 - 1020	
83	Wk-26020	1911	30	bulk peat	-27.3	70 - 240	

* Inconsistent with other dates

Comments:

- **Wk-26885 at 58 cm** calibrates to (1410-1460AD), which is inconsistent with the Kaharoa ash and the samples at 53 and 52 cm (i.e. it should be older than them, not younger). The samples at 53 and 52 cm are not likely to have much in-built age, as the dominant ecology had limited forest. The bottom layer of Kaharoa ash is at 56 cm, and should therefore date from (1300-1325AD).
- **Wk-26754 at 66 cm** is at least 120 years older than the sample at 67 cm; this could be in-built age, as the ecology was still dominated by forest at that point.
- Samples at 66 and 67 cm do not have δ 13C values. Assuming an uncertainty of 2.5 in the default value of -25 suggests that the error for these dates is 50 years rather than 30; however, the uncertainty in δ 13C may be less than 2.5.
- The Kaharoa ash spans from 39 to 56 cm. The sample at 40 cm gives a calibrated range from (1410-1460AD), suggesting that ash from surrounding areas was still being deposited in the streambed from surrounding areas for at least 100 years after the eruption, and possibly for 150 or more years afterwards. This mixing may be unsurprising, given the large-scale burning that occurred with the arrival of people at around 66 cm. This would create a large amount of uncompressed soil that was presumably prone to erosion and subsequent deposition in the streambed for a longer-than-normal period.

Implications:

- Stratigraphic/deposition models assume that deeper = older.
- Exclusion of samples at 58 and 66 cm will allow a good-fitting stratigraphic model to be constructed.
- However, there is no obvious justification for excluding these points. (Just because the points are inconvenient doesn't mean that they are wrong.)
- Alternatively, stratigraphy may be broadly correct (e.g. 50 cm is younger than 60 cm), but locally incorrect (e.g. 50 cm may be older than 51 cm due to mixing during erosional events.)

<u>2. Stratigraphic model</u>

- A series of stratigraphic models were developed
  - Wk-26885 and Wk-26754 were not used in the analyses
  - Final model presented has the weakest assumptions of models considered
  - A Poisson Sequence with 1 cm deposition rates was used, with multiple boundary layers.
- It was assumed that deposition rates would depend on the island status, and period boundaries were defined at:
  - 85 cm (bedrock)
  - 66 cm (early Māori)
  - 56 cm (beginning of Kaharoa ash)
  - 39 cm (end of Kaharoa ash)
  - 28 cm (abandonment)
  - 0 cm (modern: 2006 AD)
- No constraints were placed on the early Māori boundary at 66 cm
  - Arrival of humans in NZ circa 1280 used for comparison rather than constraint
  - defined by large increase in charcoal (macro and micro)
- A Uniform(1300, 1360AD) prior was placed on the boundary at 56 cm
  - Kaharoa eruption was between 1300 and 1325 AD (1314 best estimate)
  - 35 years added to upper date range due to the possibility of unobserved ash below 56 cm, within 2-3 cm. The 35 years was based on a preliminary model with approx. 8 years/cm, with some extra noise added to be conservative.
- A Uniform (1790,1823AD) prior was placed on the boundary at 28 cm.
  - Presence of charcoal immediately below, and vegetation change, suggests that this is at or below abandonment
  - Assuming abandonment occurred by 27 cm, 28 cm should be within approx. 35 years of abandonment, using an accumulation rate during the late Māori period of 35 years/cm, estimated by a preliminary model.
- Presence of pine pollen at 20 cm suggests a date of at least 1830. Widespread pine in NZ by 1930 led to a U(1830, 1930) date at 20cm.

Results:

- Modelled ages and unmodelled ages are similar; overall model fit is good (after excluding two radiocarbon dates).
- For depths not presented in Table 2, linear interpolation of median estimates is appropriate.
- Slow accumulation or material compression (65-80 years/cm) until arrival of Māori at 66 cm
- Very rapid accumulation during the early Māori period to the beginning of the Kaharoa tephra (from 66 to 56 cm, in depth at approx. 2 years/cm), consistent with rapid burning of the forest
- Fast accumulation from 56 to 39 cm representing ~120 years (6 years/cm); ashfall (this age could be equally explained as a near-simultaneous accumulation from 56 cm to ~45cm, and slower accumulation to 39 cm)
- Accumulation slows during late Māori period (39 to 28 cm at 35 years/cm); presumably less material to burn
- Accumulation increases post-abandonment (7 years/cm from 28 cm to modern era)
- Island settlement likely occurred soon after the arrival of humans in NZ, between 0 and 70 years before the observed ash (median estimate 20 years).

Caveats:

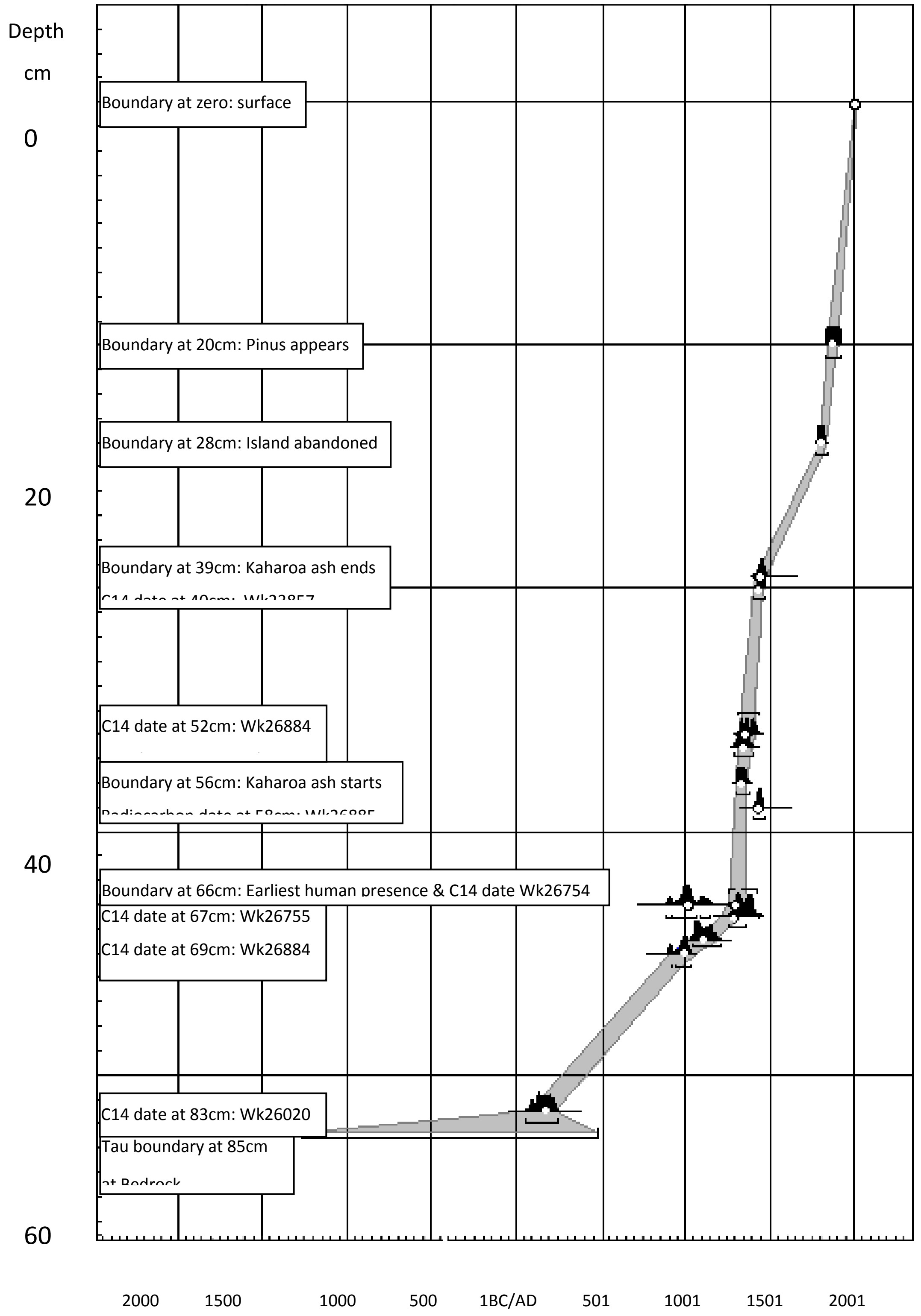
- Results conditional on the model being correct (or nearly so)
- The two radiocarbon dates could be due to: (i) lab error in date, (ii) lab error in estimate of precision, (iii) poor model assumptions (e.g. radiocarbon dates are correct, but stratigraphic assumptions are false).

Table 2. Results from the deposition model.

Depth (cm)		Unmodelled Age (AD; 95% Range)	Modelled Age (AD; Median [95% Range])
0	Modern	2006	2006 [2006 - 2006]
20	Pine pollen	1830 - 1930	1870 [1830 - 1930]
28	Abandonement	1790 - 1823	1810 [1790 - 1823]
39	Ash ends	na	1450 [1410 - 1490]
40	Wk-23857	1400 - 1460	1440 [1400 - 1480]
52	Wk-26884	1310 - 1440	1350 [1320 - 1410]
53	Wk-23858	1290 - 1400	1340 [1310 - 1400]
56	Kaharoa ash	1300 - 1360	1330 [1300 - 1360]
58	Wk-26885	1410 - 1460*	na
66	Early Maori	na	1310 [1240 - 1360]
66	Wk-26754	890 - 1150*	na
67	Wk-26755	1270 - 1400	1290 [1220 - 1330]
69	Wk-23859	1030 - 1180	1090 [1020 - 1180]
70	Wk-26019	900 - 1020	1000 [900 - 1030]
83	Wk-26020	70 - 240	160 [70 - 240]

* Not used in model

OxCal v4.0.5 Bronk Ramsey (2007); r:0.5 SHCal04 southern hemisphere atmospheric curve (McCormac et al 2004)



App 8i, Figure 1. Age versus depth for the deposition model taken from the Charles Stream Flax grove. Calendar age likelihood (light grey), posterior probability density function (bracket), and age models at 95% confidence (line).

Appendix 8ii

Carbon Dating

To determine how long people occupied rock shelter/cave site R06-17, a grant was obtained from AINSE that paid for three standard AMS dates to be obtained from ANSTO in Australia. Samples of cultural material for Radiocarbon dating were archaeologically excavated from test pit 1 and simple AMS Radiocarbon determinations were calculated by the ANSTO Laboratory.

Australian Government

Nuclear-based science benefiting all Australians

REPORT ON AMS ANALYSIS (AINSE Grant 07/153; Runs 293 & 294)

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31 October 2007

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RADIOCARBON RESULTS

	ANSTO code	Sample Type	Submitter ID	$\delta(^{13}C)$ per mil	percent Modern Carbon		Conventional Radiocarbon age	
					pMC	1 σ error	yrs BP	1 σ error
1	OZK327	Twiggy wood	Bag 211D	-25.0*	94.37	0.57	465	50
2	OZK328	Woody fibre	Bag 182	-29.1	96.98	0.42	245	40
3	OZK329	Gourd seed	Bag 213	-23.7	95.24	0.34	390	30

* -The value of $\delta(^{13}C)$ is assumed – measured data is not available

Note:

1 The $\delta(^{13}C)$ values quoted above relate solely to the graphite derived from the fraction that was used for the radiocarbon measurement. It is sometimes the case that the $\delta(^{13}C)$ of this fraction is not the same as that of the bulk material.

2 The ages quoted are radiocarbon ages, not calendar ages.

3 The ages have been rounded according to M. Stuiver and A. Polach (1977). The definition of percent Modern Carbon and Conventional Radiocarbon age can also be found in this publication.

4 Please use the ANSTO Code number in publications. The AMS facility should be referenced as Fink *et al.* (2004).

References:

D. Fink, M. Hotchkis, Q. Hua, G. Jacobsen, A. M. Smith, U. Zoppi, D. Child, C. Mifsud, H. van der Gaast, A. Williams and M. Williams (2004) The ANTARES AMS facility at ANSTO, NIM B 223-224, 109-115.

M. Stuiver and A. Polach (1977) Reporting of ^{14}C data, *Radiocarbon* 19(3), 355-363. Available on-line at:

http://radiocarbon.library.arizona.edu/radiocarbon/GetFileServlet?file=file:///data1/pdf/Radiocarbon/Volume 19/Number3/azu_radiocarbon_v19_n3_355_363_v.pdf&type=application/pdf

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Appendix 8iii

Carbon Dating

To determine how long people occupied rock shelter/cave site R06-17, a grant was obtained from AINSE that paid for three standard AMS dates to be obtained from ANSTO in Australia.

The three AMS Radiocarbon determinations for test pit 1 were calculated by the ANSTO Laboratory. Dr Peter Dillingham at the University of Otago, Department of Mathematics and Statistics calibrated these dates using the southern hemisphere calibration curve. The results of this calibration are set out here.

CALIB RADIOCARBON CALIBRATION PROGRAM*
Copyright 1986-2006 M Stuiver and PJ Reimer

*To be used in conjunction with:
Stuiver, M., and Reimer, P.J., 1993, Radiocarbon, 35, 215-230.

OZK328 [ANSTO Code number] [Labcode003] [Occupation Phase 2]
woody fibre
Radiocarbon Age 245±40
Calibration data set: shcal04.14c
McCormac et al.,2004
One Sigma Ranges: [start:end] relative area
[cal AD 1648: cal AD 1675] 0.321682
[cal AD 1738: cal AD 1798] 0.678318
Two Sigma Ranges: [start:end] relative area
[cal AD 1522: cal AD 1536] 0.007635
[cal AD 1626: cal AD 1710] 0.362018
[cal AD 1720: cal AD 1811] 0.574707
[cal AD 1837: cal AD 1848] 0.010598
[cal AD 1854: cal AD 1880] 0.021299
[cal AD 1924: cal AD 1951*] 0.023743

OZK327 [ANSTO Code number] [Labcode002] [Occupation Phase 1]
twiggy wood
Radiocarbon Age 465±100
Calibration data set: shcal04.14c
McCormac et al.,2004
One Sigma Ranges: [start:end] relative area
[cal AD 1410: cal AD 1512] 0.654578
[cal AD 1548: cal AD 1562] 0.066919
[cal AD 1570: cal AD 1622] 0.278503
Two Sigma Ranges: [start:end] relative area
[cal AD 1312: cal AD 1359] 0.041076
[cal AD 1380: cal AD 1667] 0.958032
[cal AD 1789: cal AD 1791] 0.000893

OZK329 [ANSTO Code number] [Labcode001] [Occupation Phase 1]
gourd seeds
Radiocarbon Age 390±30
Calibration data set: shcal04.14c
McCormac et al.,2004
One Sigma Ranges: [start:end] relative area
[cal AD 1464: cal AD 1510] 0.455403
[cal AD 1553: cal AD 1556] 0.031459
[cal AD 1574: cal AD 1621] 0.513138
Two Sigma Ranges: [start:end] relative area
[cal AD 1459: cal AD 1524] 0.407799
[cal AD 1527: cal AD 1533] 0.016384
[cal AD 1535: cal AD 1626] 0.575816

Ranges marked with a * are suspect due to impingment on the end of the calibration data set

FG McCormac, AG Hogg, PG Blackwell, CE Buck, TFG Higham, and PJ Reimer (2004)
SHCal04 Southern Hemisphere Calibration 0 - 11.0 cal kyr BP
Radiocarbon 46, 1087-1092

Appendix 8iv

Carbon Dating

To determine how long people occupied rock shelter/cave site R06-17, a grant was obtained from AINSE that paid for three standard AMS dates to be obtained from ANSTO in Australia.

The three AMS Radiocarbon determinations for test pit 1 were calculated by the ANSTO Laboratory (Appendix 8i). Then Dr Peter Dillingham at the University of Otago, Department of Mathematics and Statistics calibrated these dates using the southern hemisphere calibration curve (Appendix 8i). To increase the accuracy of the calendar date range for this test pit Dr Dillingham then carried out a Bayesian analysis. This involved radiometric data being incorporated with stratigraphic data from Test Pit 1 along with cultural and historic knowledge. His report is presented here.

Statistical analysis of radiocarbon data for Tawhiti Rahi, New Zealand, incorporating radiocarbon dates, stratigraphic information, and historic knowledge

Peter Dillingham

Preliminary report prepared for James Robinson

14 December 2007

[Figure 3 added 2008]

Disclaimer

This is a draft report and is not ready for publication

Abstract

Radiocarbon dates from three items recovered from a cave on Tawhiti Rahi (Poor Knights' Island), New Zealand, are combined with stratigraphic information of the archeological site. Using a Bayesian modeling framework, improved date estimates for the items are provided. The lowest cultural layer in the cave likely began between 330 and 560 BP (95% posterior probability), with a 60 – 75% probability that it began after 450 BP. This is consistent with the hypothesis that settlement of the island occurred after the beginning of the classical Māori period.

Radiocarbon dating during the course of Māori settlement of New Zealand is imprecise, and the use of Bayesian techniques leads to improvements in estimates and allows inferences to be made on the dates of fundamental interest, rather than just the dates of the radiocarbon dated items. However, these inferences are conditional upon the accuracy of model-based assumptions, and the sensitivities of model-based estimates to deviations from these assumptions were examined. For this study, the date of island settlement may be estimated reasonably well if the bottom layer is assumed to represent the beginning of settlement. Otherwise, the date of island settlement is highly dependent upon prior belief.

Introduction

Over the course of Māori settlement of New Zealand, the use of radiocarbon dating alone will often lead to imprecise inferences due to limitations with radiocarbon techniques. However, if radiocarbon data is combined with a chronological model derived from cultural and stratigraphic information, more precise estimates may result. This report highlights some of the limitations inherent in radiocarbon dating over the period of Māori settlement, and describes how cultural and stratigraphic information are incorporated into a Bayesian statistical model to provide estimates of the date of the bottom cultural layer found in a cave on Tawhiti Rahi.

The date of settlement of Tawhiti Rahi is unknown, but hypothesized to have occurred sometime after 450 BP, when the defensive benefits of an island outweighed the problems associated with difficult access and distance from trading partners (James Robinson, pers. comm.). Prior to this study, it was thought that cultural material found on the island may have been from as early as 700 BP, soon after arrival of Māori in Mayor Island, or as late as 300 BP, when nearly all agriculturally viable land was being utilized (James Robinson, pers. comm.). Three items were radiocarbon dated from cultural material found at various layers in the excavation of the cave site. Bayesian statistical methods were developed to incorporate the radiocarbon data together with a chronological model based on stratigraphic data from the cave site, additional information from the archeological record, cultural knowledge, and historic record. The date of settlement may then be estimated for a given model, as well as improved estimates for the individual dated items. Finally, the sensitivity of these estimates to alternate models was examined, allowing determination of the robustness of various estimates to the interpretation of the archeological data.

Methods

Site description

Data for this study comes from an excavation of a cave on Tawhiti Rahi, a coastal island of New Zealand. The date of settlement for Tawhiti Rahi was assumed to be between 300 BP and 700 BP, with all of these values considered equally likely prior to analysis. These dates were based on Great Barrier Island horticulture beginning c. 600 BP, Mayor Island obsidian flakes c. 700 BP, and a high population density by 300 BP suggesting that agriculturally viable land would be in use by that date (James Robinson, pers. comm.). Tawhiti Rahi had a tapu placed on it after an 1823 AD massacre, and cultural history suggests that the cave was in use at the time, while the lack of any metal found on the cave floor suggests that it has not been used in more modern times (James Robinson, pers. comm.).

There were three stratigraphic bands of cultural material in the cave, each of which was separated from the others by bands of non-cultural material (Table 1). The uppermost band consisted of material on the cave floor, followed by a dark grey layer, and then a black charcoal and ash layer. The three stratigraphic layers were not clearly distinct, and could be interpreted as one, two, or three contiguous layers distinct in time. The preferred interpretation was that there were two time layers, where the charcoal layer was considered distinct from the other two layers (James Robinson, pers. comm.). While no material from the upper layer was dated using radiocarbon techniques, numerous pig bones were found on it, and no pig bones were found below the top layer. Pigs were not introduced to New Zealand until 1769 AD by Captain Cook (James Robinson, pers. comm.). Thus, the pig bones date between arrival of pigs in 1769 AD and the 1823 AD massacre.

A piece of woody fibre from the middle band was radiocarbon dated (mean ± *s*) to 245 ± 40 BP **[ANSTO code OZK328]**. However, calendar dates, rather than radiocarbon dates, are of interest for this study, requiring that radiocarbon dates be calibrated to calendar dates. Calibration curves were based on the work of Buck and Blackwell (2004) using the southern hemisphere calibration curve SHCal04 (McCormac et al, 2004), and calculated using OxCal v.4.0.5. (Bronk Ramsey, 2007), and are described in more detail later in this report. The woody fibre radiocarbon date was calibrated to a calendar date range (95% posterior probability) of 0 – 430 BP. It is possible that the woody fibre dates from a material older than the stratigraphic layer in which it was found. However, it is suspected that the material may be flax (*Phornium tēnāx*; James Robinson, pers. comm.), suggesting that the age of the fibre is probably within 10 years of the age of the layer.

In the lowest band, two items were dated. The first item was a group of gourd seeds, with a radiocarbon date of 390 ± 30 BP, which calibrates to a calendar date range from 320 – 480 BP **[ANSTO code OZK329]**. The gourd seeds are thought to accurately represent the age of the stratigraphic layer. Further, they suggest that agriculture was occurring on Tawhiti Rahi at the time of the lowest cultural band. The other item was a piece of twiggy wood (as charcoal), with a reported radiocarbon date of 465 ± 50 BP, based on an assumption that $\delta^{13}C = -0.25‰$. However, $\delta^{13}C$ for charcoal ranges from $\delta^{13}C = -0.20‰$ to $\delta^{13}C = -0.30‰$ (Stuiver and Polach, 1977). Using the methods of Stuiver and Polach (1977), incorporating a standard deviation of $0.025‰$ in the estimate of $\delta^{13}C$ suggests that the standard error for the twiggy wood is 70 BP, rather than the reported 50 BP. This leads to a calendar date range from 320 – 550 BP **[ANSTO code OZK327]**. While it was thought that the wood was not particularly old when burned, it is possible that it was mis-identified as a twig and came from older wood than thought; of the three items, the twiggy wood was considered to be the least likely to accurately reflect the age of the stratigraphic layer in which it was found (James Robinson, pers. comm.).

Calibration of radiocarbon dates during Māori settlement of New Zealand

Radiocarbon ages are based on the assumption that the ratio of radiocarbon to stable carbon has remained constant over time. Because this assumption is untrue, it is important to calibrate radiocarbon ages with known ages using tree rings, allowing radiocarbon ages to be matched to calendar dates. Current calibration methods are based on the work of Buck and Blackwell (2004), and the southern hemisphere calibration curve was developed by McCormac et al. (2004). A radiocarbon date is calibrated to a calendar date by selecting the calendar date(s) that match the radiocarbon date, incorporating the error in both the radiocarbon date and in the calibration curve.

The calibration curve for the course of Māori settlement period is "wiggly", rather than the monotonic decreasing curve that would be ideal, with particular problems in the classic

Māoriperiod from approximately 450 BP (Fig. 1). Particular areas of concern are radiocarbon dates around 400 BP and dates more recent than 250 BP, where multiple calendar dates are consistent with individual radiocarbon dates. Calibrated calendar dates in these regions tend to produce multi-peaked probability distributions. For example, the gourd seeds **[OZK329]** found in the bottom layer of the cave have a calibrated date range of 320 – 490 BP (Fig. 2). However, it is most likely that the calendar date would be near either 350 BP or 460 BP, the location of the two peaks in Fig. 2. Because there were many changes occurring in Māori culture around 450 BP (i.e. development of Pa sites), it would be desirable to narrow the date range to one of the two peaks, if possible.

In general, radiocarbon dates for items dating to post-Māori settlement (or possible settlement) would be expected to range from approximately 100 – 800 BP. It is worthwhile examining the calibrations of radiocarbon dates in this range. Consider seven distinct radiocarbon dates, ranging from 150 to 750 BP (incremented by 100 years), each with standard deviation $\sigma = 30$ years (Table 2). Each of these radiocarbon dates is statistically distinct from its neighbours (Z-test; p = 0.02). The calibrated calendar dates for four of the seven radiocarbon dates include two separated temporal periods, and several of the regions have substantial overlap due to uncertainty in the calibration curve (Table 2). Not only may distinct radiocarbon dates lead to indistinct calendar dates due to overlap, the order may not even be preserved. For example, an item with a radiocarbon date of 150 ± 30 BP would have a distinct calendar date from one with a radiocarbon date of 250 ± 30 BP; however, without further information, it would be impossible to determine which one was older (Table 2).

Integrating chronometric and stratigraphic information

Combining additional information such as stratigraphy may improve the precision of estimates and allow inferences to extend beyond the dating of samples, especially for multi-peaked samples described above. A natural approach is through the use of Bayesian statistical methods, which have been in use in archeology for 15 years (Millard 2006). Several software tools based on Bayesian methods are available, such as Bcal (Buck et al. 1999) and OxCal software (Bronk Ramsey 2007). Analyses for this report were run using OxCal v4.0.5 (Bronk Ramsey 2007).

Bayesian statistical analyses are based on the concept of *prior* knowledge or beliefs being combined with data to form updated or *posterior* probability beliefs (Congdon 2001). Formally, this is done through Bayes theorem,

$$\Pr(A \mid B) \propto \Pr(B \mid A)\Pr(A)$$

which, for chronometric dates combined with a stratigraphic model, translates to,

$$\Pr(\text{dates} \mid \text{chronometric data}) \propto \Pr(\text{chronometric data} \mid \text{dates}) \Pr(\text{dates})$$

where $\Pr(\text{dates})$ contains prior information including stratigraphic relationships and cultural knowledge, $\Pr(\text{chronometric data} \mid \text{dates})$ is the likelihood of observing the chronometric data if the true dates were known, and $\Pr(\text{dates} \mid \text{chronometric data})$ is the posterior probability of the true dates in question (Millard, 2006).

A key concept is using stratigraphic relationships to create chronological relationships. For example, if item A is found above item B with a distinct stratigraphic layer between them, it may be logical to assume that item A is younger than item B, and that they represent two chronologically separated periods. However, in some cases, this may not be reasonable. For example, if the stratigraphic information was not definitive (i.e. there may have been mixing or disturbance in the area where the items were found), or there was reason to believe that a large amount of material was deposited in a short period of time, the assumption that item A is younger than item B, or that they represent distinct chronological periods, may no longer be reasonable. Different statistical models may be developed based on alternate chronological interpretations of stratigraphic data.

Additional information beyond stratigraphic relationships may also be incorporated. For example, knowledge of the stratigraphy of the cave suggests that the gourd seeds **[OZK329]** and twiggy wood **[OZK327]** should be older than the woody fibre**[OZK32]**, while knowledge of the 1823 AD tapu placed on Tawhiti Rahi, and the belief that the cave was in use at the time, imply that cultural items found on the cave floor must date prior to 1823 AD.

One of the great benefits of the Bayesian modeling approach is that the development and implementation of complex models is vastly simplified versus classical methods, allowing integration of multiple sources of data in a straightforward manner. However, care is needed when using these methods. Data that does not agree with the underlying model can cause convergence problems, or, worse, misleading results. For example, dated material may not represent the date of the stratigraphic layer in which it was found (i.e. disturbance or dating of old wood). The agreement index (Bronk Ramsey, 1995) was used to assess consistency between the dating evidence and the modelled dates for each dated item (A) and the overall model ($A_{overall}$), with values near 1 for consistent items, where values below 0.6 indicate poor fit. Additionally, a variety of sensitivity analyses were run to determine the robustness of parameter estimates to various interpretations of the stratigraphic data.

Chronological model

The primary chronological model was consistent with the stratigraphic data (Table 1) and other available information. The date of Māori settlement of the island (ϕ_1) was assumed to be between 300 and 700 BP. Assuming that use of the cave site began shortly after arrival of Māori on the island, the lower boundary of the bottom layer of cultural material (α_1) is a reasonable proxy for ϕ_1 (i.e. $\phi_1 = \alpha_1$). However, this requires several assuming that the cave site was in use shortly after settlement, and there was no missed cultural material below this layer. A less strong interpretation assumes that settlement occurred prior to use of the cave (i.e. $\phi_1 < \alpha_1$); results from this secondary model are also presented. To determine which of these assumptions is more likely to be correct would require a body of evidence from multiple sites. The gourd seeds, indicative of agricultural use and found in the bottom layer, justify the assumption that settlement occurred prior to the bottom layer of cultural material (i.e. it is unlikely that this layer results from a short-term exploration of the island pre-settlement). The twiggy wood and the gourd seeds were assumed to accurately date from the bottom layer. The non-cultural layer was assumed to represent a chronological gap, so that the lower boundary of the middle layer was later than the upper boundary of the bottom layer (i.e. $\beta_1 < \alpha_2$), and the woody fibre was assumed to date from this layer. After another chronological gap related to a non-cultural layer (i.e. $\beta_2 < \alpha_3$), the upper layers were assumed to represent two contiguous chronological layers, where the black charcoal layer was earlier but adjacent to the combined cave floor/dark grey material layer (i.e. β_3 is the upper boundary of the charcoal layer and the lower boundary of the cave floor/dark grey). The pig bone found on the cave floor was assumed to date between 1769 AD and 1823 AD, while the upper boundary of the top layer was assumed to be 1823 AD, indicating the cave was in use at the time of the massacre.

Alternate models were developed to assess the sensitivity of the modelled dates to the chronological interpretation of the stratigraphic data, as different models will nearly always produce different estimates for the parameters of interest. Thus, the sensitivity of a parameter to model assumptions can be based on the differences observed between various models. The sensitivities of modelled dates were classified as insensitive (less than 20 years difference), moderately sensitive (20 to 50 years change), or sensitive (more than 50 years difference). The alternate interpretations considered were (a) that the top layer represented 1 or 3 layers, and (b) all non-cultural material layers were deposited quickly, so that the stratigraphic gaps indicated chronological boundaries rather than gaps. Items within a layer were assumed to be uniformly distributed in time; alternate distribution assumptions were considered to test the sensitivity of results to this assumption. Further, while there was no evidence of disturbance between layers for this study, two of the items (twiggy wood and woody fibre) may have dated from older wood; models were also run where biases in the dates of the items were assumed.

Results

Model fit

There was no evidence of problems with model fit, with $A_{overall} = 1.0$ for both models, as well as for the models used in sensitivity analyses. While the possibility that the twiggy wood or the woody fibre may represent old wood was considered, there was no evidence of poor fit for either item ($A = 0.9$ for twiggy wood, $A = 1.0$ for woody fibre). However, model fit could still be reasonable even with substantial bias in some of the radiocarbon data (i.e. if old wood was dated), and the influence of possible bias in the dated items was explored. Parameter estimates were insensitive to an assumed bias in the twiggy wood of 50 years, while a bias of at least 100 years was needed to change any parameter by 50 years or more. A bias of more than 250 years was inconsistent with the models ($A < 0.6$). This suggests that the twiggy wood could be representative of the layer in which it was found (as thought), but even a relatively large bias in its age would have a small impact on other parameter estimates. Model results were insensitive to a bias in the woody fibre of 20 years, and only two parameters (α_2, β_2) were even moderately sensitive to a bias of 50 years; parameters of primary interest (ϕ_1, α_1) were insensitive to much large biases. Hence, the assumption that the items accurately date the layers in which they were found was reasonable, and even moderately large violations of those assumptions have small impacts on the inferences of primary interest. Finally, parameter results were insensitive to alternate but plausible chronological interpretations of the stratigraphic data, or to assumptions about the distribution of items within layers.

Model based estimates (Fig.3)

Including the information from the chronological models with the dated items resulted in the conclusion that there was a 60 – 75% probability that the lowest cultural layer found in the cave dates more recently than the development of Pa sites *ca.* 450 BP, a 10 – 15% probability that it dates more recently than 350 BP, and more than a 95% probability that it dates more recently than 550 BP, with a calendar date range of 330 – 560 BP (95% posterior probability).

Inferences about the date of settlement are more varied, and depend substantially on the assumption of whether or not the bottom cultural layer represents the date of island settlement (i.e. $\phi_1 = \alpha_1$ or $\phi_1 < \alpha_1$). The estimated probabilities that settlement occurred after 350 BP, 450 BP, or 550 BP are *ca.* 10, 60, and 95% (if $\phi_1 = \alpha_1$), or *ca.* 0, 15, and 45% (if $\phi_1 < \alpha_1$). The latter probabilities are influenced not just by the assumption that $\phi_1 < \alpha_1$, but also by the distributional form of the prior assumption about ϕ_1, and should be viewed very cautiously. In either case, it is reasonable to infer that settlement occurred prior to 350 BP, with probability between 90 and 100%, and that the bottom layer of cultural material likely dates after the development of Pa sites around 450 BP (60 – 75% probability).

If use of the cave occurred very shortly after settlement of the island, the lowest cultural layer provides a reasonable estimate for the date of island settlement, suggesting that the island was settled between 330 and 560 BP. If not, it provides an upper bound for the date of settlement (i.e. $\phi_1 < \alpha_1$), and the model suggests that settlement occurred between 390 and 700 BP, although this range should be viewed with caution. While the early end of this range is similar to the estimate from the other assumption (390 BP vs. 330 BP), the latter end of the range varies substantially more (700 BP vs. 560 BP). However, under the assumption that $\phi_1 < \alpha_1$, the latter end of this range is based entirely on the prior assumption that settlement may have occurred as early as 700 BP. In this case, dated items, cultural information specific to the site, and stratigraphic relationships only influence the more recent boundary for the estimate of ϕ_1.

However, when $\phi_1 < \alpha_1$, the estimated date range for α_1 is 330 to 530 BP, similar to the range when $\phi_1 = \alpha_1$ (330 – 560 BP). Thus, the estimate of ϕ_1 is very sensitive to the assumption of $\phi_1 = \alpha_1$ or $\phi_1 < \alpha_1$, while α_1 is only moderately sensitive to this choice. All more recent parameters were insensitive to this choice. This is a quantification of a qualitative argument. That is, inferences on dates prior to the beginning of the archeological record are less reliable and based on assumption, become more robust for dates after the beginning of archeological data, and the influence of assumptions about early dates do not generally trickle far above the beginning of the archeological record.

In addition to allowing inferences to be made directly about the parameters of fundamental interest (island settlement, beginning of the bottom layer), use of the Bayesian models allowed more precise estimates for the dated items (Table 3), conditional on the model being accurate. In general, these parameters were insensitive to alternate interpretations of the archeological evidence, unless those interpretations specifically involved the parameter of interest. The two items found in the bottom layer have modelled dates of approximately 320 – 490 BP (gourd seeds) and 320 – 510 BP (twiggy wood). The modelled and unmodelled estimates for the gourd seeds are equivalent, while the lower bound for the twiggy wood is changed from 550 BP. The largest improvement in precision was for the woody fibre, where an unmodelled date range of modern – 430 BP was improved to 160 – 320 BP after incorporating additional information. Finally, an upper bound on the time from settlement until the development of agriculture can be estimate by the difference between the date of the gourd seeds and ϕ_1. If $\phi_1 = \alpha_1$, this difference is less than 120 years (95% posterior probability). However, if $\phi_1 < \alpha_1$, the time from settlement to agriculture could have taken as long as 340 years; once again, this latter estimate is highly influenced by prior assumptions.

Discussion

The use of Bayesian methods that combine radiocarbon data with a chronological model of stratigraphic data as well as cultural and historic knowledge allows inferences to be made on the date of settlement of the island. However, as could be expected, inference on the early end of the date range is highly influenced by whether or not the lowest cultural layer in the cave was assumed to begin very shortly after settlement. Under either assumption, settlement likely occurred prior to 350 BP (90% or greater probability). Inferences about the date for the beginning of the bottom layer were more robust, not changing by more than 30 years from each other, while modelled dates for the two items found on the bottom layer were insensitive to the model choice. The more conservative range suggests that the bottom layer began between 330 and 560 BP. While this range straddles the development of Pa sites *ca.* 450 BP, it more likely occurs after 450 BP (60 – 75% probability). Finally, if the assumption that $\phi_1 = \alpha_1$ is valid, this suggests that agricultural use occurred within 120 years of settlement, based on the estimated difference between the date of the gourd seeds and settlement.

In addition to allowing inferences to be made on the parameters of fundamental interest (i.e. island settlement, use of the cave), the precision of date range estimates for the radiocarbon dated items improved for the twiggy wood (20% more precise) and the woody fibre (60% more precise). These improvements were insensitive to the model choice, and were found to be robust in sensitivity analyses, suggesting that a wide variety of interpretations of stratigraphic data can result in similar modelled estimates. Much of this work could be done qualitatively and achieve similar results. However, by using a quantitative approach, it is possible to determine which estimates are robust to various assumptions, and which ones are not.

Knowledge of the calibration curve over the course of Māori settlement may also be used to plan future work. For example, activities that occurred between 350 and 500 BP would be expected to have similar uncalibrated radiocarbon dates (350 – 400 BP), rendering them virtually indistinguishable (Fig. 1). Hence, there are limited benefits to dating additional items in the bottom layer of the cave, and the best use of additional resources likely is elsewhere. In particular, finding additional sites that can support or refute the assumption that use of the cave site began shortly after settlement would be of more benefit. If multiple sites have bottom layers with similar date ranges, there is increased support that those layers represent early settlement.

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Figures and Tables

Figure 1. Southern hemisphere radiocarbon calibration curve (McCormac et al, 2004) from 750 BP to 0 BP. Figure produced using OxCal v4.0.5 (Bronk Ramsey, 2007).

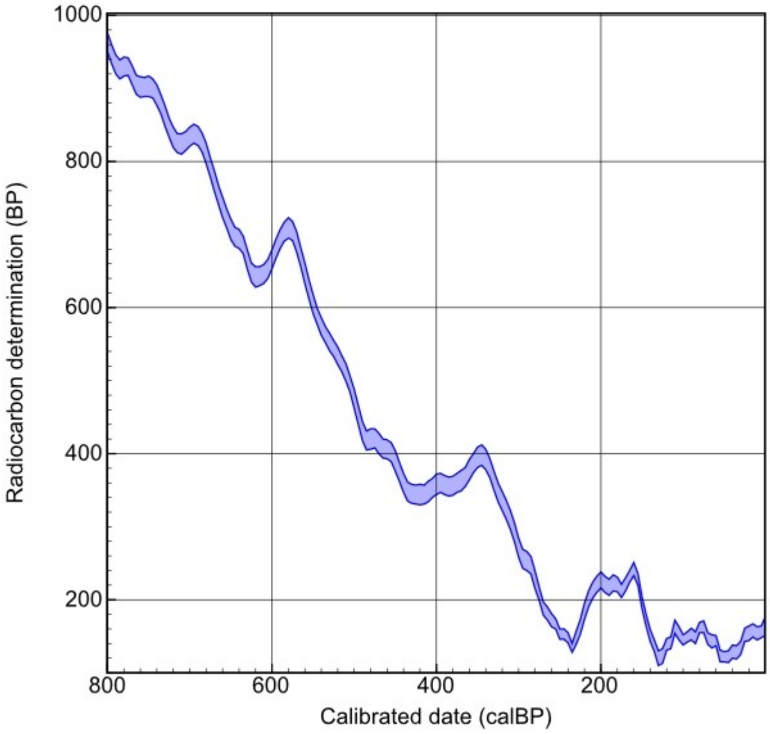

Figure 2. Example calendar date probability plot for the gourd seed in XXX Cave, with a radiocarbon age of 390±30 calibrated to the Southern hemisphere radiocarbon calibration curve (McCormac et al, 2004), with highest posterior probability areas near 450 BP and 350 BP. Figure produced using OxCal v4.0.5 (Bronk Ramsey, 2007).

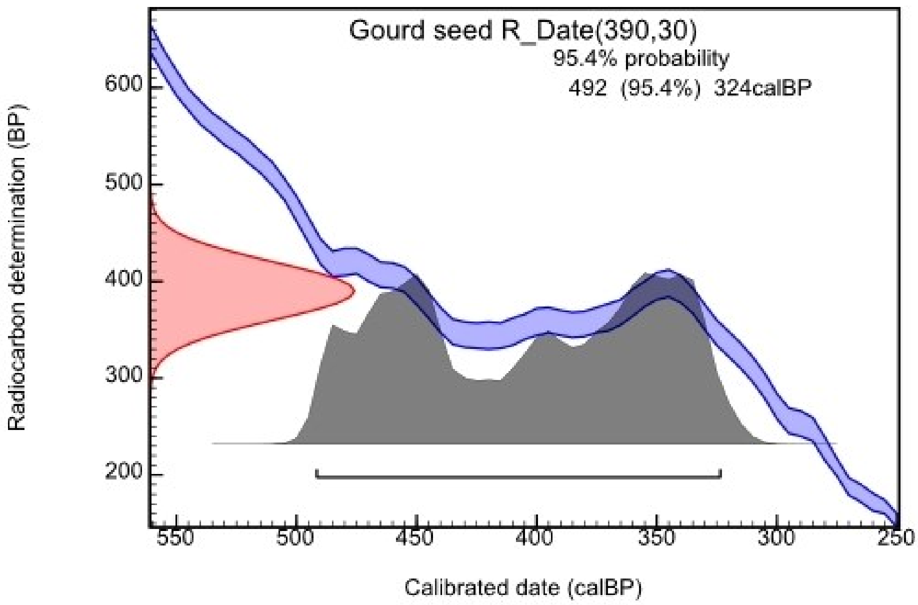

Figure 3. Bayesian modelling provides improved calendar date estimates from the cave site Test Pit 1

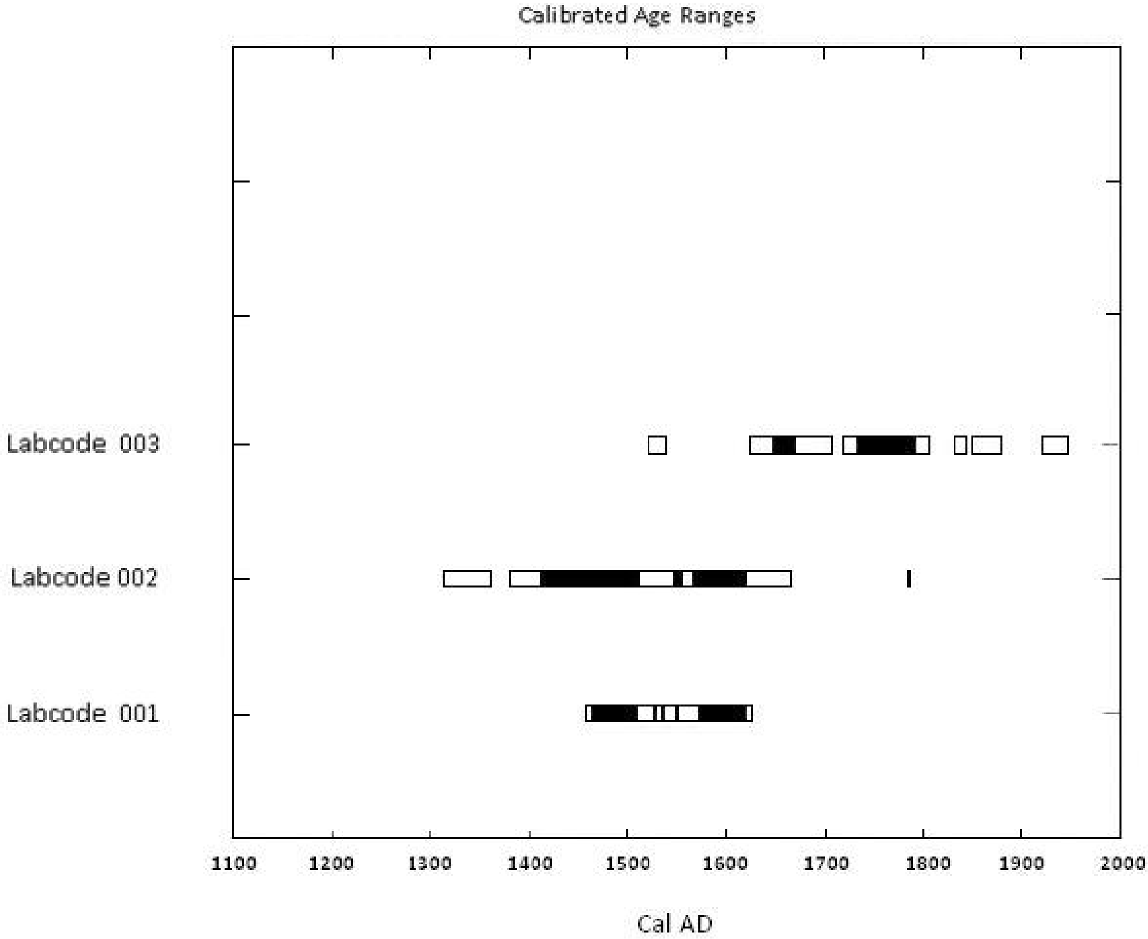

Table 1. Stratigraphic description and assumed chronology for the cave excavation. The primary model assumed that β_3 = 1823 AD, α_1 occurred after the settlement of the island, and settlement occurred sometime between 1250 and 1650 AD.

Description	Cultural	Depth (cm)		Time boundaries	
		upper	lower	upper	lower
cave floor	Yes	na	na	β_4	
dark grey	Yes	0	3		β_3
black charcoal	Yes	3	4	β_3	α_3
grey ash	No	4	7		
fibre and bone	Yes	7	9	β_2	α_2
dark grey	No	9	12		
various	Yes	12	14	β_1	α_1
dark grey	No	14	19		
dark orange-brown	No	19	lower		

Table 2. Calibrated calendar dates for given radiocarbon dates with standard deviation $\sigma = 30$. Adjacent radiocarbon dates are statistically distinct from each other (Z-test; p = 0.02), while corresponding calendar dates may not be. The shape of the calibration curve is indicated as monotonic or not.

Radiocarbon date (± 30 BP)	Monotonic calibration	Calendar date range (BP)
150	No	0 - 150; 210 - 270
250	No	150 - 220; 260 - 320
350	No	300 - 460
450	No	330 - 360; 450 - 520
550	Yes	500 - 550
650	No	540 - 650
750	No	560 - 600; 630 - 720

Table 3. Model-based estimates (years BP) for the cave on Tawhiti Rahi, assuming the beginning of the bottom layer (α_1) coincides with island settlement (ϕ_1), or if it occurs after settlement.

Parameter or item	Modelled estimates (BP)	
	Model 1: $\phi_1 = \alpha_1$	Model 2: $\phi_1 < \alpha_1$
β_4	127	127
pig bone	127 - 170	127 - 170
β_3	127 - 220	127 - 220
α_3	130 - 270	130 - 270
β_2	150 - 310	150 - 310
woody fibre	160 - 320	160 - 320
α_2	180 - 400	180 - 400
β_1	280 - 480	280 - 480
gourd seeds	320 - 490	320 - 490
twiggy wood	320 - 510	320 - 500
α_1	330 - 560	330 - 530
ϕ_1	330 - 560	390 - 700

Appendix 8v

Carbon Dating

To determine when the gardens were built on Tawhiti Rahi charcoal was recovered from the base of a stone row [Feature OBJID 1744] situated in the north-east garden. Unidentified charcoal was floated from a soil sample taken from L2 in test pit 3 immediately below the rows foundation rocks. This ample was sent to the University of Waikato for radiocarbon determinations and southern hemisphere curve calibrated dates. These are shown here.

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Report on Radiocarbon Age Determination for Wk- 30311

(AMS measurement)

Submitter	J. Robinson
Submitter's Code	Bag 08, Poor Knights, Tk 116, TP3
Site & Location	Poor Knights Islands, New Zealand
Sample Material	Charcoal
Physical Pretreatment	Sample cleaned.
Chemical Pretreatment	Sample washed in hot HCl, rinsed and treated with multiple hot NaOH washes. The NaOH insoluble fraction was treated with hot HCl, filtered, rinsed and dried.

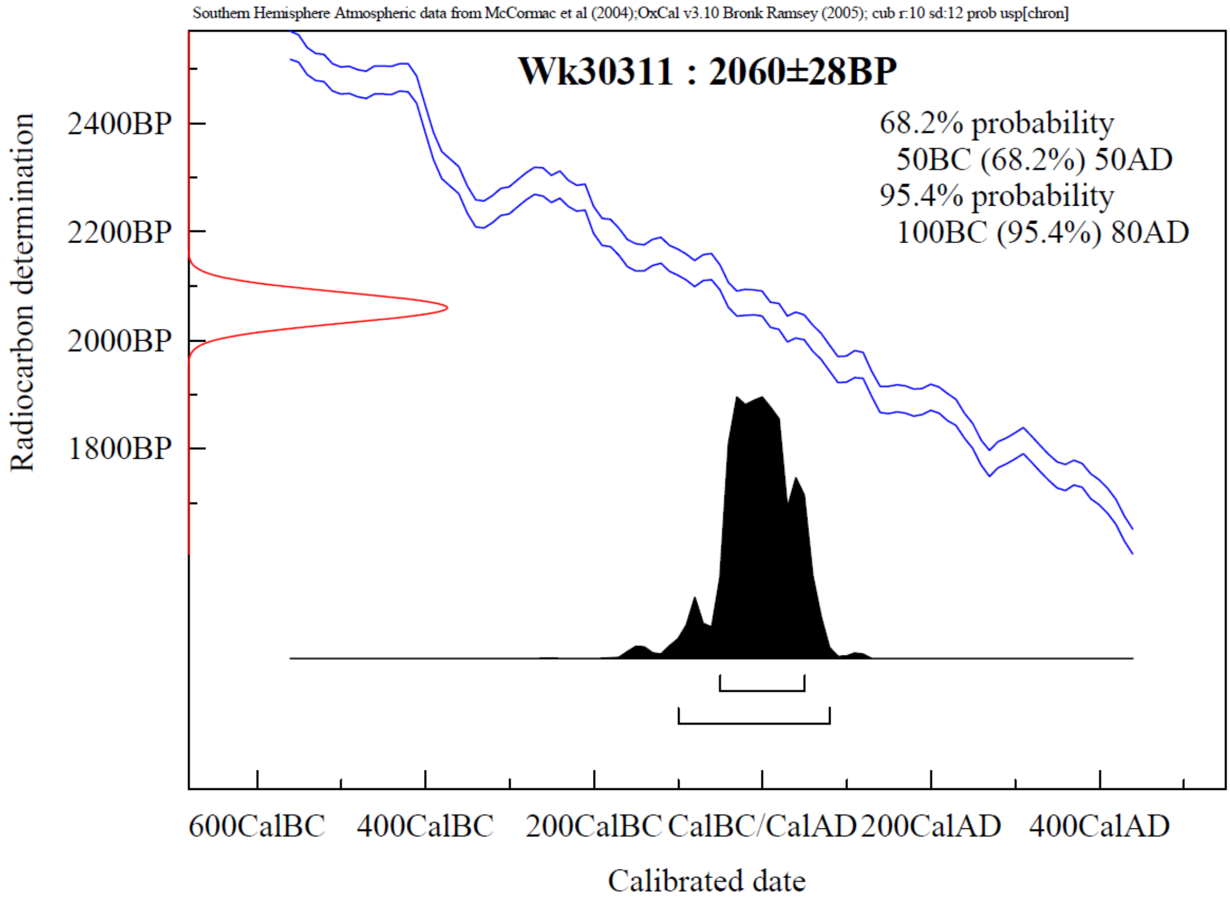
$\delta^{13}C$	-24.5 ±	0.2 ‰
$D^{14}C$	-226.2 ±	2.7 ‰
$F^{14}C\%$	77.4 ±	0.3 %
Result	**2060 ± 28 BP**	

Comments

A G Hogg

31/03/11

- Result is *Conventional Age or Percent Modern Carbon (pMC)* following Stuiver and Polach, 1977, Radiocarbon 19, 355-363. This is based on the Libby half-life of 5568 yr with correction for isotopic fractionation applied. This age is normally quoted in publications and must include the appropriate error term and Wk number.
- Quoted errors are 1 standard deviation due to counting statistics multiplied by an experimentally determined Laboratory Error Multiplier.
- The isotopic fractionation, $\delta^{13}C$, is expressed as ‰ wrt PDB.
- $F^{14}C\%$ is also known :*Percent Modern Carbon (pMC)* .



Southern Hemisphere Atmospheric data from McCormac et al (2004);OxCal v3.10 Bronk Ramsey (2005); cub r:10 sd:12 prob usp[chron]
Wk30311 : 2060±28BP
68.2% probability
50BC (68.2%) 50AD
95.4% probability
100BC (95.4%) 80AD
Radiocarbon determination
2400BP
2200BP
2000BP
1800BP
600CalBC
400CalBC
200CalBC
CalBC/CalAD
200CalAD
400CalAD
Calibrated date

Appendix 9

Associate Professor Christa Mulder of the University of Alaska collected weather data on Tawhiti Rahi Island by between February 2005 and January 2006. This unpublished data included mean daily temperature of 14.85 (that is four degrees higher than the mainland), a mean daily dew point of 13.81°C, an absolute humidity (in g per m3), and a relative humidity (in %) that averages out to 97°C (Appendix 9). The full data is presented here.

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
02/14/04	16.69	**15.4-18.95 February 2004 range**	14.32	**11.62-18.53 February mean daily range**	12.32	86.18	**88.83**
02/15/04	16.53		14.05		12.01	85.50	
02/16/04	16.72		14.63		12.46	87.75	
02/17/04	16.63		13.91		11.90	84.23	
02/18/04	17.57		15.38		13.03	87.08	
02/19/04	16.83		14.50		12.41	86.82	
02/20/04	16.55		14.20		12.16	86.05	
02/21/04	19.66		17.73		15.05	89.10	
02/22/04	18.43		16.54		13.98	88.87	
02/23/04	18.54		17.85		15.26	95.88	
02/24/04	15.44		11.62		10.27	78.08	
02/25/04	15.90		12.67		11.02	81.25	
02/26/04	17.61		15.52		13.14	87.62	
02/27/04	18.95		18.53		15.86	97.81	
02/28/04	18.20		18.19		15.56	102.74	
02/29/04	16.53		15.81		13.43	96.37	
03/01/04	17.56	**14.27 - 17.57 March range**	16.46	**9.95-17.06 March range**	13.96	93.41	**86.93**
03/02/04	16.49		14.46		12.34	88.08	
03/03/04	15.03		11.63		10.29	80.26	
03/04/04	15.13		12.51		10.90	84.58	
03/05/04	15.40		13.57		11.67	89.09	
03/06/04	16.44		14.22		12.17	86.82	
03/07/04	17.57		16.19		13.71	91.67	
03/08/04	17.49		15.71		13.30	89.46	
03/09/04	17.71		16.63		14.10	93.43	
03/10/04	17.22		15.36		13.07	89.24	
03/11/04	15.89		13.17		11.35	84.13	
03/12/04	16.15		12.13		10.60	77.17	
03/13/04	16.15		13.23		11.39	83.13	
03/14/04	16.74		13.98		11.95	83.90	
03/15/04	17.68		16.28		13.81	91.67	
03/16/04	17.39		17.06		14.50	98.23	
03/17/04	16.55		16.28		13.84	98.82	
03/18/04	15.65		14.21		12.16	91.42	
03/19/04	15.83		13.80		11.87	87.78	
03/20/04	16.66		15.62		13.27	93.67	
03/21/04	17.04		15.86		13.45	92.97	
03/22/04	15.89		13.34		11.49	84.94	
03/23/04	16.24		13.87		11.87	86.02	
03/24/04	15.24		11.44		10.18	78.21	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
03/25/04	15.18		12.30		10.76	83.07	
03/26/04	15.81		13.88		11.90	88.43	
03/27/04	15.51		12.28		10.74	81.53	
03/28/04	14.27		9.95		9.24	75.59	
03/29/04	15.00		11.01		9.89	77.18	
03/30/04	15.81		12.92		11.17	83.07	
03/31/04	15.87		13.85		11.87	88.02	
04/01/04	16.70	**13.50 - 17.35 Apr il range**	14.08	**8.90-17.34 April range**	12.00	84.74	**90.43**
04/02/04	17.04		15.17		12.89	88.91	
04/03/04	15.59		12.29		10.73	80.77	
04/04/04	15.04		12.81		11.14	86.75	
04/05/04	13.40		10.56		9.65	83.07	
04/06/04	12.57		8.90		8.65	78.56	
04/07/04	13.50		9.09		8.81	74.77	
04/08/04	14.74		12.61		11.00	87.58	
04/09/04	14.20		10.52		9.60	78.54	
04/10/04	14.12		11.61		10.33	85.12	
04/11/04	13.84		10.33		9.48	79.75	
04/12/04	14.36		10.87		9.81	79.76	
04/13/04	15.17		12.20		10.71	82.69	
04/14/04	15.50		15.27		13.01	98.80	
04/15/04	15.64		15.32		13.06	98.63	
04/16/04	15.48		14.72		12.58	95.28	
04/17/04	15.26		14.59		12.47	95.83	
04/18/04	16.19		14.83		12.62	91.76	
04/19/04	16.05		14.08		12.04	88.23	
04/20/04	15.46		15.46		13.18	101.24	
04/21/04	14.88		14.03		12.05	94.85	
04/22/04	15.84		15.00		12.78	94.79	
04/23/04	15.75		14.66		12.51	93.35	
04/24/04	15.90		13.89		11.89	88.12	
04/25/04	16.30		15.31		13.04	93.91	
04/26/04	16.20		16.12		13.71	100.74	
04/27/04	16.56		16.52		14.05	102.06	
04/28/04	16.56		16.39		13.94	100.89	
04/29/04	17.15		17.00		14.47	100.96	
04/30/04	17.35		17.34		14.79	102.57	
05/01/04	19.26	**12.11 - 19.26 May range**	19.26	**12.00-19.26 May range**	16.53	104.03	**100.6**
05/02/04	18.15		18.15		15.51	104.10	
05/03/04	14.20		13.48		11.74	97.96	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
05/04/04	14.22		13.35		11.55	94.55	
05/05/04	15.18		14.07		12.08	93.33	
05/06/04	14.45		13.75		11.85	95.72	
05/07/04	14.26		13.64		11.77	96.35	
05/08/04	15.13		14.63		12.53	97.27	
05/09/04	16.46		15.92		13.53	96.76	
05/10/04	16.48		16.45		13.98	102.17	
05/11/04	17.66		17.66		15.06	103.30	
05/12/04	15.18		15.18		12.96	104.10	
05/13/04	15.18		15.18		12.96	104.10	
05/14/04	14.42		14.29		12.26	101.66	
05/15/04	13.11		12.77		11.17	98.46	
05/16/04	13.12		12.82		11.22	98.42	
05/17/04	13.42		13.13		11.43	100.26	
05/18/04	14.42		13.99		12.04	97.73	
05/19/04	14.59		14.57		12.47	102.97	
05/20/04	14.29		14.21		12.21	101.12	
05/21/04	13.21		13.10		11.43	101.23	
05/22/04	12.13		12.00		10.66	102.28	
05/23/04	12.59		12.14		10.74	98.90	
05/24/04	12.11		12.10		10.73	103.36	
05/25/04	12.73		12.72		11.16	103.29	
05/26/04	13.43		13.43		11.65	103.28	
05/27/04	15.11		15.07		12.88	102.66	
05/28/04	13.67		13.65		11.81	103.36	
05/29/04	12.66		12.66		11.11	103.75	
05/30/04	12.20		12.11		10.71	102.14	
05/31/04	13.06		12.76		11.18	100.03	
06/01/04	13.85	**11.14 - 15.97 June range**	13.79	**9.96-15.97 June range**	11.91	102.01	**102.26**
06/02/04	14.16		14.16		12.19	103.48	
06/03/04	15.21		15.21		12.98	103.33	
06/04/04	14.02		14.02		12.12	103.86	
06/05/04	11.14		10.97		10.00	101.03	
06/06/04	11.64		11.30		10.19	99.95	
06/07/04	11.56		11.49		10.31	102.11	
06/08/04	11.50		11.15		10.10	99.93	
06/09/04	11.80		11.36		10.23	99.19	
06/10/04	11.37		11.26		10.17	101.35	
06/11/04	11.55		11.12		10.09	99.35	
06/12/04	12.94		12.57		11.04	99.75	
06/13/04	12.38		12.38		10.94	103.91	
06/14/04	12.97		12.93		11.30	102.86	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
06/15/04	14.26		14.25		12.26	103.15	
06/16/04	15.54		15.54		13.24	104.08	
06/17/04	15.97		15.97		13.58	104.10	
06/18/04	13.55		13.55		11.74	104.10	
06/19/04	15.39		15.39		13.15	104.10	
06/20/04	14.45		14.45		12.40	103.59	
06/21/04	11.97		11.85		10.59	101.92	
06/22/04	10.29		9.96		9.37	99.91	
06/23/04	11.24		11.24		10.19	103.58	
06/24/04	11.16		11.15		10.11	103.68	
06/25/04	12.75		12.74		11.19	102.83	
06/26/04	14.59		14.51		12.45	102.42	
06/27/04	13.11		13.11		11.44	104.10	
06/28/04	11.70		11.70		10.46	103.83	
06/29/04	11.58		11.45		10.29	102.05	
06/30/04	12.06		11.60		10.39	98.11	**12.8575**
07/01/04	12.58	**8.72 - 13.63 July range**	12.01	**7.89-13.63 July range**	10.65	97.72	**100.25**
07/02/04	12.03		11.22		10.13	96.41	
07/03/04	11.06		10.29		9.55	95.50	
07/04/04	11.07		10.57		9.75	98.13	
07/05/04	13.13		13.13		11.43	104.10	
07/06/04	12.42		12.42		10.96	104.10	
07/07/04	11.20		11.05		10.04	102.16	
07/08/04	12.22		11.28		10.16	94.04	
07/09/04	11.66		10.74		9.82	94.33	
07/10/04	11.46		10.65		9.77	94.81	
07/11/04	10.31		9.65		9.17	96.58	
07/12/04	11.25		10.26		9.53	94.07	
07/13/04	11.54		11.35		10.23	100.54	
07/14/04	13.16		13.08		11.41	101.68	
07/15/04	12.30		12.30		10.87	104.10	
07/16/04	10.84		10.84		9.91	104.02	
07/17/04	11.07		10.97		9.99	102.06	
07/18/04	10.65		10.31		9.57	99.79	
07/19/04	11.51		11.46		10.31	102.79	
07/20/04	11.63		11.62		10.40	103.57	
07/21/04	10.37		10.36		9.63	103.02	
07/22/04	9.11		8.78		8.70	100.04	
07/23/04	8.72		7.89		8.20	95.83	
07/24/04	10.33		9.92		9.37	98.87	
07/25/04	11.03		10.99		10.01	102.59	
07/26/04	12.98		12.96		11.31	103.09	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
07/27/04	13.63		13.63		11.79	104.10	
07/28/04	13.05		13.05		11.39	104.10	
07/29/04	11.36		11.24		10.15	102.10	
07/30/04	10.37		10.26		9.55	101.73	
07/31/04	9.86		9.74		9.25	101.73	
08/01/04	10.48	**7.46 - 13.75 August range**	10.48	**6.07-13.75 August range**	9.70	104.10	**100.95**
08/02/04	10.27		10.27		9.57	103.69	
08/03/04	11.67		11.67		10.45	103.83	
08/04/04	13.75		13.75		11.88	104.10	
08/05/04	12.56		12.56		11.05	104.07	
08/06/04	11.22		11.22		10.15	103.67	
08/07/04	11.12		11.10		10.08	102.51	
08/08/04	10.90		10.55		9.72	99.72	
08/09/04	10.56		10.56		9.74	103.53	
08/10/04	10.61		10.47		9.70	101.98	
08/11/04	10.91		10.90		9.99	103.47	
08/12/04	12.28		12.21		10.81	102.87	
08/13/04	12.42		12.42		10.97	104.05	
08/14/04	13.40		13.37		11.61	103.38	
08/15/04	9.84		9.77		9.33	102.65	
08/16/04	7.46		6.79		7.64	97.18	
08/17/04	8.43		8.13		8.37	99.82	
08/18/04	11.18		11.15		10.12	102.63	
08/19/04	11.04		11.04		10.04	103.42	
08/20/04	10.57		10.57		9.75	103.46	
08/21/04	10.74		10.74		9.87	103.94	
08/22/04	11.71		11.71		10.48	104.05	
08/23/04	9.49		9.48		9.10	103.57	
08/24/04	8.89		8.27		8.41	97.50	
08/25/04	8.55		7.25		7.87	93.13	
08/26/04	8.92		8.70		8.66	100.68	
08/27/04	8.37		7.48		8.00	96.07	
08/28/04	8.16		6.07		7.27	87.93	
08/29/04	8.57		6.81		7.62	89.24	
08/30/04	9.37		8.78		8.68	96.90	
08/31/04	11.47		11.43		10.33	102.46	
09/01/04	11.43	**9.72 - 14.23 September range**	11.43	**9.66-14.23 September range**	10.28	104.10	**100.51**
09/02/04	9.72		9.67		9.21	103.26	
09/03/04	9.85		9.74		9.24	101.93	
09/04/04	10.36		10.19		9.54	100.96	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
09/05/04	10.64		10.54		9.74	101.96	
09/06/04	10.88		10.62		9.77	100.46	
09/07/04	11.14		9.76		9.21	91.61	
09/08/04	11.64		10.88		9.91	95.83	
09/09/04	12.72		12.14		10.75	96.69	
09/10/04	13.59		13.50		11.70	101.72	
09/11/04	14.23		14.23		12.24	103.54	
09/12/04	13.63		13.63		11.79	104.10	
09/13/04	11.40		11.35		10.26	102.62	
09/14/04	11.22		11.07		10.06	101.19	
09/15/04	12.23		12.20		10.85	102.62	
09/16/04	10.71		10.59		9.77	101.94	
09/17/04	11.21		11.13		10.15	102.06	
09/18/04	11.63		11.48		10.31	101.29	
09/19/04	10.45		10.18		9.52	99.98	
09/20/04	11.15		10.94		9.99	101.25	
09/21/04	11.78		11.14		10.09	97.25	
09/22/04	12.63		12.14		10.82	97.57	
09/23/04	14.07		14.05		12.12	102.74	
09/24/04	12.67		12.67		11.13	103.99	
09/25/04	10.98		10.38		9.63	98.08	
09/26/04	11.57		11.33		10.24	101.21	
09/27/04	12.32		12.27		10.86	102.57	
09/28/04	11.00		9.66		9.17	93.00	
09/29/04	11.40		10.74		9.85	97.37	
09/30/04	12.84		12.73		11.16	102.38	
10/01/04	11.28	**11.28 - 16.74 October range**	10.65	**10.5-16.74 October range**	9.79	98.32	**101.39**
10/02/04	12.20		11.39		10.24	96.26	
10/03/04	12.85		12.46		10.99	100.61	
10/04/04	12.84		12.61		11.08	101.94	
10/05/04	11.35		10.94		9.99	99.96	
10/06/04	12.21		12.12		10.74	102.83	
10/07/04	12.24		12.24		10.82	104.10	
10/08/04	12.38		12.38		10.92	104.10	
10/09/04	13.21		13.21		11.49	104.05	
10/10/04	11.85		11.64		10.43	101.13	
10/11/04	12.26		11.88		10.57	99.69	
10/12/04	13.65		13.53		11.79	102.14	
10/13/04	15.33		15.31		13.15	103.27	
10/14/04	14.96		14.90		12.78	102.86	
10/15/04	15.10		15.09		12.90	103.87	
10/16/04	13.36		13.36		11.60	104.10	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
10/17/04	12.57		11.89		10.57	97.93	
10/18/04	11.62		10.50		9.68	94.43	
10/19/04	11.73		10.95		9.97	96.70	
10/20/04	12.28		11.81		10.54	99.11	
10/21/04	11.87		11.44		10.30	99.17	
10/22/04	14.09		14.05		12.13	102.92	
10/23/04	15.70		15.70		13.37	104.10	
10/24/04	15.73		15.73		13.40	104.10	
10/25/04	15.50		15.50		13.22	104.10	
10/26/04	13.81		13.81		11.92	104.06	
10/27/04	14.30		14.30		12.33	103.94	
10/28/04	16.74		16.74		14.25	104.10	
10/29/04	13.92		13.84		11.94	102.97	
10/30/04	12.50		12.12		10.73	100.43	
10/31/04	12.78		11.85		10.53	95.65	
11/01/04	14.70	**12.07 - 17.08 November range**	14.38	**11.25-17.25 November range**	12.34	100.40	**100.43**
11/02/04	14.25		14.24		12.26	103.34	
11/03/04	14.98		14.28		12.23	97.60	
11/04/04	15.17		13.88		11.92	94.47	
11/05/04	15.17		14.90		12.78	100.67	
11/06/04	15.55		15.21		12.99	100.81	
11/07/04	15.63		15.49		13.22	101.87	
11/08/04	15.96		15.57		13.27	100.43	
11/09/04	16.20		16.12		13.77	102.74	
11/10/04	16.50		16.39		13.99	102.69	
11/11/04	17.05		16.65		14.18	100.23	
11/12/04	17.02		16.82		14.32	101.71	
11/13/04	17.08		17.08		14.56	104.10	
11/14/04	15.30		15.11		12.93	101.92	
11/15/04	15.18		15.15		13.01	103.11	
11/16/04	13.86		13.58		11.77	101.31	
11/17/04	14.15		13.85		11.99	100.42	
11/18/04	14.53		14.25		12.27	100.69	
11/19/04	15.10		15.02		12.88	102.72	
11/20/04	14.89		14.79		12.68	102.64	
11/21/04	14.12		13.08		11.36	95.12	
11/22/04	15.08		14.97		12.90	101.86	
11/23/04	13.56		13.53		11.74	103.46	
11/24/04	12.99		12.84		11.28	102.30	
11/25/04	12.11		11.40		10.27	97.98	
11/26/04	12.07		11.25		10.18	96.66	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
11/27/04	13.87		13.57		11.79	101.12	
11/28/04	15.81		15.32		13.11	99.09	
11/29/04	15.54		13.76		11.83	90.76	
11/30/04	15.94		15.66		13.42	100.75	
12/01/04	18.06	**13.11 - 18.06 December range**	18.02	**11.13-18.02 December range**	15.43	103.18	**99.78**
12/02/04	16.40		15.38		13.08	95.86	
12/03/04	13.27		13.22		11.51	102.81	
12/04/04	11.67		11.13		10.08	99.25	
12/05/04	13.36		12.60		11.07	96.58	
12/06/04	14.10		13.30		11.53	97.02	
12/07/04	14.33		13.51		11.72	96.51	
12/08/04	14.86		13.80		11.90	95.21	
12/09/04	15.15		13.88		11.93	93.81	
12/10/04	15.37		13.15		11.38	87.86	
12/11/04	15.07		13.59		11.76	92.01	
12/12/04	14.76		14.69		12.58	103.14	
12/13/04	14.22		14.03		12.13	101.97	
12/14/04	16.96		16.96		14.48	103.99	
12/15/04	16.24		16.22		13.82	103.56	
12/16/04	14.79		14.10		12.17	98.03	
12/17/04	13.11		12.75		11.18	100.69	
12/18/04	11.89		11.21		10.19	98.16	
12/19/04	13.90		13.10		11.47	97.24	
12/20/04	14.52		14.49		12.43	103.60	
12/21/04	14.26		14.17		12.21	102.68	
12/22/04	14.63		14.60		12.53	103.20	
12/23/04	14.26		13.98		12.05	101.05	
12/24/04	14.14		13.51		11.72	98.63	
12/25/04	13.69		13.02		11.36	98.02	
12/26/04	15.12		14.64		12.55	99.70	
12/27/04	15.81		15.79		13.50	103.55	
12/28/04	16.99		16.99		14.47	104.10	
12/29/04	16.83		16.83		14.34	104.10	
12/30/04	16.11		16.11		13.76	104.08	
12/31/04	16.50		16.50		14.04	103.64	
01/01/05	15.79	**15.29 - 20.15 January 2005 mean range**	15.77	**14.57-19.92 January 2005 mean**	13.47	103.34	**101.91**
01/02/05	15.29		15.26		13.03	103.13	
01/03/05	16.54		16.25		13.86	101.69	
01/04/05	17.38		17.35		14.81	103.23	

Date	Temp mean daily [C]	Temp mean range [C]	Dew point point mean daily [C]	Dew point mean range [C]	Absolute humidity (in g per m3)	Relative humidity %	Average
01/05/05	18.31		18.31		15.68	104.01	
01/06/05	18.35		18.35		15.69	104.10	
01/07/05	17.68		17.68		15.08	103.98	
01/08/05	15.25		15.25		13.02	104.00	
01/09/05	16.58		16.58		14.13	103.79	
01/10/05	16.37		16.34		13.92	103.18	
01/11/05	16.84		16.66		14.21	102.06	
01/12/05	17.12		16.85		14.37	101.02	
01/13/05	16.88		16.51		14.09	100.88	
01/14/05	17.72		17.38		14.85	100.58	
01/15/05	17.34		17.05		14.55	101.02	
01/16/05	18.09		17.76		15.16	101.12	
01/17/05	17.21		17.06		14.55	102.15	
01/18/05	16.34		14.57		12.44	91.13	
01/19/05	16.70		15.92		13.67	97.68	
01/20/05	17.63		17.07		14.55	99.29	
01/21/05	18.17		18.05		15.47	102.39	
01/22/05	19.17		19.17		16.53	103.84	
01/23/05	18.57		18.57		15.91	104.08	
01/24/05	19.30		19.30		16.64	104.07	
01/25/05	20.15		19.92		17.31	102.01	**17.39**

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